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THE APPLICATION OF  
REMOTE SENSING TO  
RESOURCE MANAGEMENT AND  
ENVIRONMENTAL QUALITY PROGRAMS IN  
KANSAS

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**THE UNIVERSITY OF KANSAS CENTER FOR RESEARCH, INC.**

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## ABSTRACT

Activities of the Kansas Applied Remote Sensing Program (KARS) are designed to establish interactions on cooperative projects with decision makers in Kansas agencies in the development and application of remote sensing procedures. This report describes the activities of the KARS program in pursuit of its objectives during the period April 1, 1975, through March 31, 1976.

Cooperative demonstration projects were undertaken with several different agencies during this period and involved three principal areas of effort: Wildlife Habitat and Environmental Analysis; Urban and Regional Analysis; Agricultural and Rural Analysis. These projects were designed to concentrate remote sensing concepts and methodologies on existing agency problems to insure the continued relevancy of the program and maximize the possibility for immediate operational use.

Completed projects during the period include (1) the decision to use demolition methods to restore nesting habitats at Cheyenne Bottoms Waterfowl Management Area in central Kansas, (2) the conservation and reclamation of habitat suitable for the lesser prairie chicken (Tympanuchus pallidicinctus) in southwest Kansas, (3) the delineation of refuse collection areas in Kansas City, Kansas, (4) the determination of census tract divisions in the Kansas City Metropolitan Area, (5) the location of a canoe trail and campsites along the Republican River in north central Kansas and (6) the decision to withhold State financial aid for the proposed reservoir in County Line Lake, Missouri.

Other projects were initiated during this period and are nearing completion or awaiting final action.

# I. THE KANSAS APPLIED REMOTE SENSING PROGRAM

## INTRODUCTION

The unique contemporary problems facing officials at all levels of government have created a need for objective data gathering to supplement or in some cases replace traditional methodologies. The need for objective data gathering has been further emphasized by the increasing pressures from social, environmental and economic considerations.

The University of Kansas Applied Remote Sensing Program (KARS) has established a continuing program of activities to demonstrate the utility of remote sensing technology in data gathering to decision makers in state, regional and local agencies. Now in its fourth year, the KARS program is developing the concepts and methodologies to utilize remote sensing procedures in dealing with significant problems in Kansas related to changing urbanization patterns, rapid irrigation growth, changing agricultural needs and environmental quality. This activity is accomplished primarily through cooperative remote sensing projects with governmental agencies in Kansas on problems of immediate concern.

This report outlines the activities and accomplishments of the KARS program during the period April 1, 1975 through March 31, 1976 in pursuit of its key objectives:

- To apply remote sensing techniques, analysis and systems to the solution of significant decision oriented concerns of state and local officials.

- To participate cooperatively on remote sensing projects with state and local agencies in Kansas.

- To effect the transfer of applicable remote sensing technology to governmental agencies at all levels as a by-product of the demonstration projects conducted in the KARS program.

- To assist the personnel within Kansas agencies in the evaluation of the capabilities of the rapidly changing remote sensing systems and the benefits which might be achieved through their utilization.

- Through multidisciplinary teams, to stimulate the application



of the products of remote sensing systems to the significant problems of resource management and environmental quality in Kansas.

To guide, assist and stimulate faculty, staff and students in the utilization of information from the Earth Resources Satellite and Aircraft Programs of NASA in research, education and public service activities carried out at the University of Kansas and in the State.

The interaction which results from these cooperative projects insures the continued relevancy of the program and maximizes the transfer of these new and emerging technological systems to operational use.

#### CONTACTS WITH AGENCIES

While projects usually develop through individual contacts between agency and KARS personnel, communications also result from more general information dissemination efforts aimed at promoting widespread interest in remote sensing applications. During the past year these activities have included (1) a KARS sponsored image interpretation short course, (2) publication of the *KARS Newsletter*, and publication of a review article in the *Kansas Water News*.

During the week of March 15-19 the KARS Program was the sponsor of a short course conducted by Douglas S. Way, Associate Professor in the Harvard University Graduate School of Design. Participants having a wide variety of interests, backgrounds (geology, geography, engineering, transportation), and from a number of localities, studied methods of site evaluation using aerial imagery.

The course emphasized procedures that can be followed to facilitate acquisition of information through remote sensing and/or aerial photographic interpretation techniques to arrive at efficient, effective decisions concerning problems associated with development of inherent site features. Topics covered included image interpretation of landforms, geologic features, soils, vegetation, and land use. Methods for estimating depth of soil to bedrock, and depth to water table using aerial imagery were also examined. Though the course focussed on the utilization of large scale aerial photography, the uses of other sensors including LANDSAT and Skylab were also reviewed. The course

served to introduce KARS and agency personnel to more effective interpretation techniques and aided in furthering outreach of the KARS Program.

A recent article written for the *Kansas Water News* (Vol. 17, Nos. 3 & 4) is providing additional information concerning uses of remote sensing and the nature of the KARS Program. This journal is widely read in Kansas, especially by decision makers in natural resource management agencies. The article complements and supplements information provided through the quarterly *KARS Newsletter*. The Newsletter now reaches over 700 readers with news of current KARS projects and activities (Appendix I). Several new projects have developed from contacts resulting from these media.

There continues to be substantial demand for the Kansas LANDSAT Mosaic and Kansas Land Use Patterns Map published in 1974. These have greatly increased the visibility of the KARS Program across Kansas.

#### COORDINATION WITH AGENCY OFFICIALS

Experience gained in the KARS Program has demonstrated that it is not sufficient to hold conferences, publish newsletters, or make occasional calls on agency personnel. A continuing association with key administrators and their staffs is carried on to develop their interest, promote KARS projects, and finally obtain agency commitment of time and resources for the projects.

During the last year we have increased personal visits to Kansas agencies. The visits are facilitating better communications between KARS and agency personnel. Agencies with which contacts have been established are listed in Table A. Contacts are maintained with all of these agencies and additional contacts actively pursued.

#### NATURE OF PROJECTS

Table B indicates the range of projects completed during FY 75-76. Note in Figure 1 that projects have been distributed widely over Kansas. Additionally, some have been undertaken in Missouri which has no comparable remote sensing applications program.

#### PERSONNEL

The Applications Program is administered by Dean B. G. Barr, Professor

**Table A**  
**AGENCIES WITH WHICH CONTACTS HAVE BEEN ESTABLISHED**  
**BY THE KANSAS APPLIED REMOTE SENSING PROGRAM**

<b>Municipal:</b>	Kansas City, Kansas Department of Planning and Development Kansas City, Kansas City Commission Lawrence, Kansas Planning Department	Kansas City, Kansas Mayor's Office Lawrence, Kansas City Engineer Lawrence, Kansas City Commission Concordia, Kansas Chamber of Commerce
<b>County:</b>	Douglas, Kansas Planning Department Cloud, Kansas Commissioners	Cherokee, Kansas Board of Commissioners Douglas, Kansas County Extension Agent
<b>State:</b>	Kansas Forestry, Fish and Game Commission Kansas Water Resources Board Kansas Department of Economic Development Missouri Clean Water Commission Kansas Governor's Office Kansas Department of Agriculture Kansas Geological Survey Kansas Attorney General's Office	Kansas Parks and Resources Authority Kansas Department of State Planning Kansas Department of Revenue Kansas Department of Health and Environment Kansas Highway Department Kansas Agricultural Extension Service Missouri Governor's Office Missouri Department of Natural Resources
<b>Regional:</b>	Mid-America Regional Council Chikaskia-Indian Hills Regional Planning Commission (Sumner, Harper, Kingman) Northwest Kansas Planning and Development Commission (Cheyenne, Sherman, Wallace, Rawlins, Thomas, Logan, Decatur, Sheridan, Gove, Norton, Graham, Trego, Phillips, Rooks, Ellis, Smith Osborne, and Russell Counties, Kansas) Sunflower Resource Conservation & Development District (Sumner, Harper, Kingman, Pratt, Barber, Comanche, and Kiowa counties, Kansas)	Four Rivers Resource Conservation & Development District (Jewell, Republic, Mitchell, Cloud, Ottawa, Lincoln, Ellsworth, and Saline counties, Kansas) Ozarks Regional Commission Big Lakes Regional Planning Commission (Pottawatomie, Riley, Geary)
<b>Federal:</b>	U. S. Department of Agriculture, Soil Conservation Service U. S. Fish and Wildlife Service	U. S. Army Corps of Engineers, Kansas City Office U. S. Environmental Protection Agency, Kansas City Office

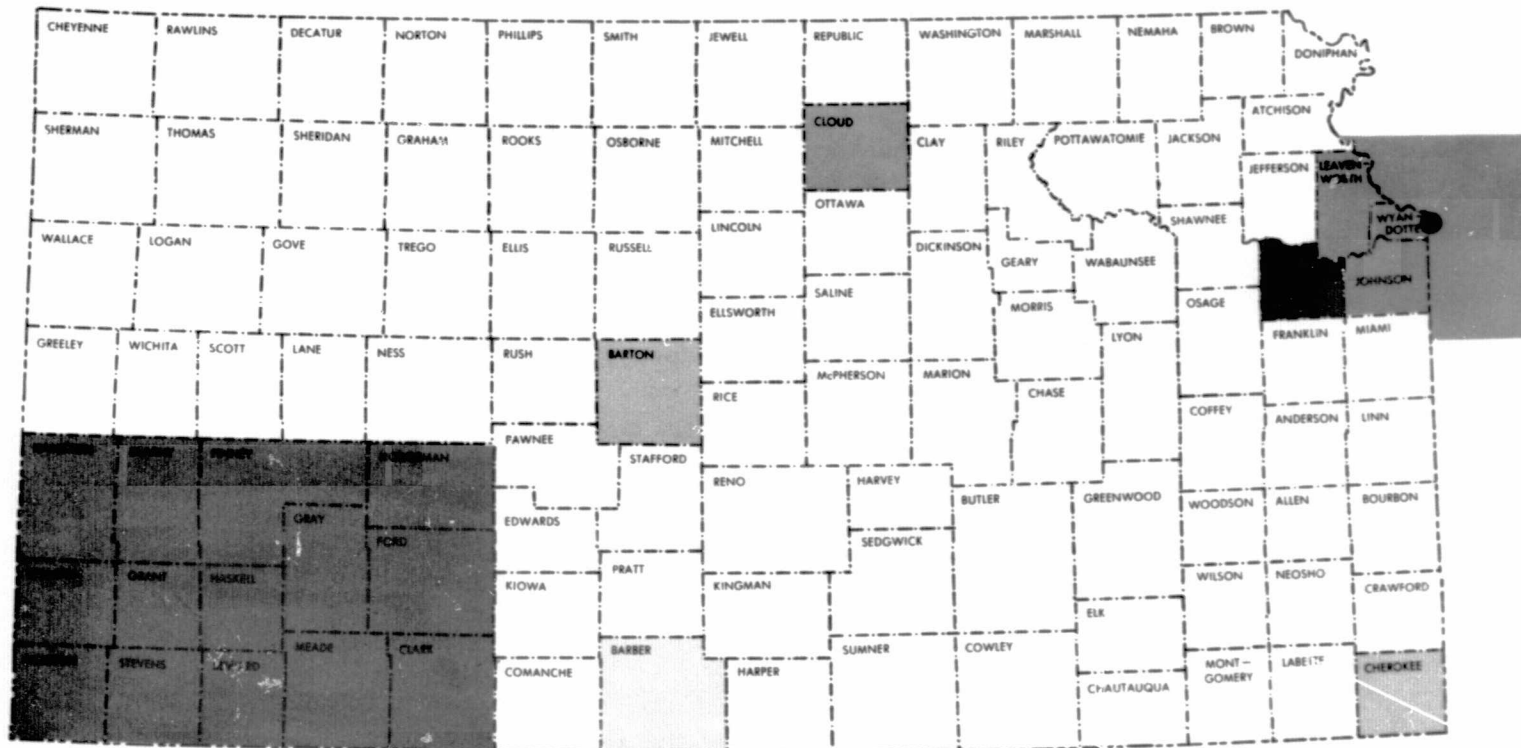
TABLE B  
COMPLETED PROJECTS  
KARS PROGRAM  
MARCH 1975 - APRIL 1976

PROJECT:	Mapping and Monitoring of Vegetation in Cheyenne Bottoms Waterfowl Management Area
COUNTY INVOLVED:	Barton
COOPERATING AGENCY:	Kansas Forestry, Fish and Game Commission
PROJECT:	Mapping Center Pivot Irrigation in Southwest Kansas
COUNTIES INVOLVED:	Hamilton, Stanton, Morton, Kearney, Grant, Stevens, Finney, Haskell, Seward, Gray, Meade, Hodgeman, Ford, Clark
COOPERATING AGENCIES:	Kansas Forestry, Fish and Game Commission, Kansas Water Resources Board, Kansas Geological Survey
PROJECT:	Sanitation Route Allocation in Kansas City, Kansas
COUNTY INVOLVED:	Wyandotte
COOPERATING AGENCY:	Department of Planning and Development, Kansas City, Kansas
PROJECT:	Census Tract Division
COUNTIES INVOLVED:	Johnson, Kansas
	Jackson, Clay, Missouri
COOPERATING AGENCY:	Mid-America Regional Council (MARC)
PROJECT:	Republican River Canoe Trail Planning
COUNTY INVOLVED:	Cloud
COOPERATING AGENCY:	Cloud County Commissioners, Four Rivers RC&D, Concordia Chamber of Commerce, Kansas Park and Resources Authority
PROJECT:	Decision on County Line Lake, Missouri
COUNTIES INVOLVED:	Webster, Greene, Mo.
COOPERATING AGENCIES:	Missouri Department of Natural Resources, Missouri Governor's Office
PROJECT:	Mapping Aquatic Vegetation at Douglas County State Lake
COUNTY INVOLVED:	Douglas
COOPERATING AGENCY:	Kansas Forestry, Fish and Game Commission
PROJECT:	Mapping Drainage Patterns in Strip Mined Areas
COUNTY INVOLVED:	Cherokee
COOPERATING AGENCIES:	Kansas Forestry, Fish and Game Commission, Kansas Department of Health and Environment, Kansas Attorney General's Office
PROJECT:	Mapping Urban Expansion on Prime Agricultural Lands
COUNTIES INVOLVED:	Johnson, Leavenworth, Wyandotte, Kansas and Jackson, Clay, Ray, Cass, Platte, Missouri
COOPERATING AGENCY:	Mid-America Regional Council (MARC)
PROJECT:	Evaluation of Rangeland Quality
COUNTIES INVOLVED:	Barber
COOPERATING AGENCIES:	Kansas Department of Agriculture (Weed and Pesticide Division), U. S. Soil Conservation Service Sunflower RC&D Project

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# REMOTE SENSING APPLICATIONS PROJECTS

April, 1975 - March, 1976



- Cheyenne Bottoms WMA Project
- Center Pivot Irrigation Project
- Refuse Collection In Kansas City, Kansas
- Mid-America Regional Council (MARC) Projects
- Douglas County State Lake Project
- Strip Mined Areas Drainage Project
- Redcedar Infestation Project
- Republican River Canoe Trail Project

Figure 1. During the past year KARS projects have been undertaken in 22 Kansas counties.



of Engineering and Director of the University of Kansas Space Technology Center. Barr, a specialist in Engineering management, has been active in transmitting new technologies to industry and state agencies for over ten years.

A major improvement in the Program's management was initiated during the past year and will be continued during the coming year. Dr. Edward A. Martinko, Instructor in the Biological Sciences Division of the University and Research Associate in the Center for Research was appointed Project Coordinator and has assumed primary responsibility for agency contacts, scheduling and the accomplishment of demonstration projects by the joint agency-KARS teams. Dr. Martinko brings several years of experience in multidisciplinary research projects to the team. He was a research assistant in the State Biological Survey of Kansas for two years and has an excellent working relationship with the agricultural community.

Messrs. James Merchant, C. T. Traylor and Joseph Poracsky, doctoral candidates in the Department of Geography with considerable professional experience as image interpreters and cartographers, carry significant responsibilities in the KARS Program. Additional expertise in various disciplines and interpretive skills is provided by Glenn Sheppard, Ronald Shaklee and Ted Talmon.

Projects requiring major scientific effort are staffed primarily by graduate students from the various academic disciplines assisted by faculty advisors when appropriate. Personnel from the various state and local agencies are involved in their applications projects at no cost to the NASA grant. We continue to work with the various extension agencies in the state to gain their assistance in translating remote sensing technology to a broader audience.

#### FACILITIES

The KARS laboratory located on the second floor of the KU Space Technology Center serves as the headquarters of the Kansas Applied Remote Sensing Program. Light tables, Bausch and Lomb Zoom Transfer Scope and other equipment needed by the KARS team have been provided by the Space Technology Center for the demonstration projects. In-house graphic arts and photo services facilities offer complete cartographic and film processing services. Computation services are available both

in-house and through remote terminal to the University computer center.

In the last FY the KARS Program has acquired important additional equipment from government surplus to aid in the interpretation of remotely sensed images. An Itek Color Additive Viewer/Printer (ACVP) was obtained on surplus from NASA. The ACVP has the ability to enlarge, superimpose, and register up to four separate black and white transparencies for viewing, printing, or color enhancement. Both LANDSAT imagery and aerial photography in 70 mm formats can be accommodated.

In addition to the ACVP the KARS Project has obtained a Variscan Rear Screen Variable Magnification Viewer. This instrument, also obtained on surplus, is capable of rear projection of film transparencies of any size from 35 mm to 9½ inches in format at several enlargements up to approximately 48 times the original scale. These additional instruments will complement optical equipment now on hand in the KARS Program laboratory, will allow more involved interpretation, and will help expedite image analysis.

New procedures have also been established for more efficiently producing quality products for agency use. These procedures include mapping on stable base materials in negative mode and using color preseparation overlays to display data. This allows the user to separate the interpretation categories into individual displays, provides for inexpensive multiple copy reproduction, and increases the possibility that the material can be used by more than one agency.

A current file of LANDSAT, Skylab and aerial imagery is maintained in the KARS laboratory for the use of project personnel and user agencies. The LANDSAT file contains the best quality imagery for specific time periods during the year. The imagery is catalogued in an accessible file providing complete coverage of Kansas.

A Guide to Remotely Sensed Data for Kansas is being compiled by KARS personnel for agency use. This publication, to be available in August 1976, will provide the following information: 1.) information on the KARS Program, 2.) sources of remotely sensed data and methods for acquiring imagery, 3.) selected maps of image coverage, 4.) short descriptions of sensors (e.g. LANDSAT), and 5.) indications of imagery and services available through the KARS Program.

The KARS Program also maintains a substantial reference library for both in-house and agency use. This material includes reports, articles, periodicals, manuals, text books, etc.

## II. PROGRAM OF WORK APRIL 1, 1975 - MARCH 31, 1976

### A. COMPLETED PROJECTS

During the period April 1975 - March 1976, KARS Program personnel have completed six major projects upon which decisions have been made by cooperating agencies. These include (1) the decision to use demolition methods to restore nesting habitats at Cheyenne Bottoms Waterfowl Management Area in central Kansas, (2) the conservation and reclamation of habitat suitable for the lesser prairie chicken (Tympanuchus pallidicinctus) in southwest Kansas, (3) the delineation of refuse collection areas in Kansas City, Kansas, (4) the determinations of census tract divisions in the Kansas City Metropolitan Area, (5) the location of a canoe trail and campsites along the Republican River in north central Kansas and (6) the decision to withhold state financial aid for the proposed reservoir on County Line Lake, Missouri. Details of these projects follow.

### Wildlife Habitat and Environmental Analysis

#### HABITAT MANAGEMENT DECISIONS AT CHEYENNE BOTTOMS WATERFOWL MANAGEMENT AREA, KANSAS

Waterfowl comprise an important aesthetic and recreational component of the wildlife populations of North America. Cheyenne Bottoms Waterfowl Management Area, encompassing some 19,000 acres in Barton County, Kansas, is one of the most important waterfowl refuge and hunting tracts along the Central Flyway, perhaps second only to Sand Lake, S. D. Hunters, wildlife observers, and nature photographers use the "Bottoms" in excess of 18,000 man/days annually. In an average year the marsh experiences about 5,000,000 waterfowl use weeks (1 waterfowl use week = 1 waterfowl in residence 1 week).

About 15 million water birds use the Bottoms each year. Large numbers of shorebirds and waterfowl nest, breed, and winter on the wetlands. Up to 50,000 mallards normally remain in the Bottoms area throughout the cold season leaving only for short periods of extremely low temperatures when the marsh freezes over. Depending on weather conditions, 5,000 - 30,000 geese (mostly canadas) also winter at

Cheyenne Bottoms. At least 14 species of ducks nest and breed in the wetlands.

The substantial year-round resident populations of waterfowl are expanded many times during migration periods in spring and early fall. As many as 600,000 ducks and 40,000 geese, mostly canadas or whitefronts, have been censused at one time. In addition, the area is extremely important to almost 100 other species of water birds (such as pelicans, herons, cranes, sandpipers, gulls, and terns) during migration seasons. Over 300 species of birds other than waterfowl have been reported in the area.

Sustained elevated waterfowl and shorebird population levels at Cheyenne Bottoms (and similar waterfowl management areas) are largely dependent on the degree to which optimal habitat conditions are maintained in the marsh. These conditions include adequate water levels, dependable water supply, and vegetation types not only favorable for feeding, but also distributed in such a way to provide sufficient nesting habitat.

For centuries erratic fluctuations in habitat conditions, largely caused by high evaporation rates and by variations in quantities of water flowing into the natural basin in which the Bottoms is located, resulted in widely varying numbers of waterfowl. In 1937 the Kansas Forestry, Fish and Game (KFF&G) Commission took over control and management of the Bottoms. During the early 1950's a system of dikes and canals was constructed in the marsh to provide for the more efficient control of water necessary to properly manage the Bottoms for waterfowl. The basin was divided into five separate pools, each of which could be filled or drained independently of the others (Figure 2).

Management procedures at the Bottoms are similar to those used in other waterfowl management areas. Seasonal draining and flooding of the pools helps control undesirable vegetation, promotes production of desirable food and cover plants, permits seeding of Japanese millet and farm crops, and allows maintenance of dikes, dams, blinds, canals and water control structures.

At Cheyenne Bottoms, management techniques are based on summer drainage of some pools, summer aerial seeding of vegetation, and reflooding of the pools in the fall. All pools are maintained at full



elevation, 18 inches of water, until spring migration has passed. A rotation of draining pools has been established so that each unit is drained and aerially seeded to Japanese millet every third year. Ideally, water is removed from certain pools in late May then diverted back into the pools in late August or early September.

KFF&G Management personnel have had, however, some difficulty in establishing and maintaining suitable habitat conditions. Furthermore they would find it highly advantageous to be able to monitor the effectiveness of their management programs in order to decide which are most productive.

One of the major challenges facing KFF&G managers at Cheyenne Bottoms is to increase the vegetation-water interspersation in various sections of the marsh. In general, waterfowl and other marsh denizens prefer to inhabit highly interspersed habitats with open water for feeding, nesting and travel. Poor nesting habitat develops in those areas where the density of the natural vegetation, Typha latifolia (broad-leaf cattail), Typha angustifolia (narrow-leaf cattail), and Scirpus fluviatilis (river bulrush), excludes open water areas. In pool 3, for example, the vegetation has formed a dense 'mat'. Birds flying over these areas of poor interspersation pass on because there are few resting spots and food is scarce. Attempts to cut the vegetation to provide open water and increase food productivity have been futile, since the vegetation quickly reverts to its former density. Locating problem areas where vegetation has left little open water and monitoring these sites to determine if management procedures are producing the desired effects are difficult tasks to complete with ordinary ground operations.

KARS project personnel are working with KFF&G managers and biologists on the use of remote sensing for habitat management. Black and white infrared aerial photography was acquired over Cheyenne Bottoms by the KU aircraft in August 1974 and was supplemented by 1:17,000 color infrared photography acquired commercially in September 1974. This imagery is serving as an immediate tool with which vegetation changes monitored on LANDSAT imagery may later be compared and measured. The aerial photography was mosaiced and delivered to management personnel. It was to be used to map existing aquatic vegetation and to locate

areas of cattail to test some techniques designed to promote better vegetation-water interspersion.

On the mosaic, however, several large "potholes" in suitable nesting habitats were visible (Figure 3). These areas had not been apparent in ground operations. Study of the area and past data accumulated for 15 - 20 years, revealed that the area with good interspersion of water and vegetation had been blasted with charges of ammonium nitrate, fuel oil and dynamite during the early 1960's as an experiment to control vegetation density. Because of the manpower and equipment limitations at Cheyenne Bottoms, the blasting procedure offered an attractive method for reclaiming poor habitat by restoring open water areas. *KFF&G, therefore, decided to institute these methods to restore nesting habitats and had their waterfowl manager, Mr. Robert Bartels, trained in these methods of control. The first areas to be blasted (pool 2) were then subsequently selected from the mosaic.*

Ongoing management efforts in poor nesting areas, and vegetation changes in suitable habitats are being monitored with regularly scheduled LANDSAT infrared imagery. A series of time sequential "pool histories" have been compiled from LANDSAT imagery and delivered to wildlife biologists working at the "Bottoms". Managers can observe on this imagery changes in each pool that have occurred since July 1972. Seasonal changes in growth and distribution of marsh plants and alterations in vegetal patterns from year to year are readily apparent. KFF&G has requested funds to continue monitoring vegetation changes in Cheyenne Bottoms with aerial photography and LANDSAT imagery.

Aerial imagery has enabled KFF&G wildlife biologists to assess the effectiveness of various management schemes used in the past which are designed to "open" areas overly congested with vegetation. They have been able to determine that one technique, involving the use of explosive charges, has had notable lasting effects, and have decided to employ this technique on a more widespread basis.

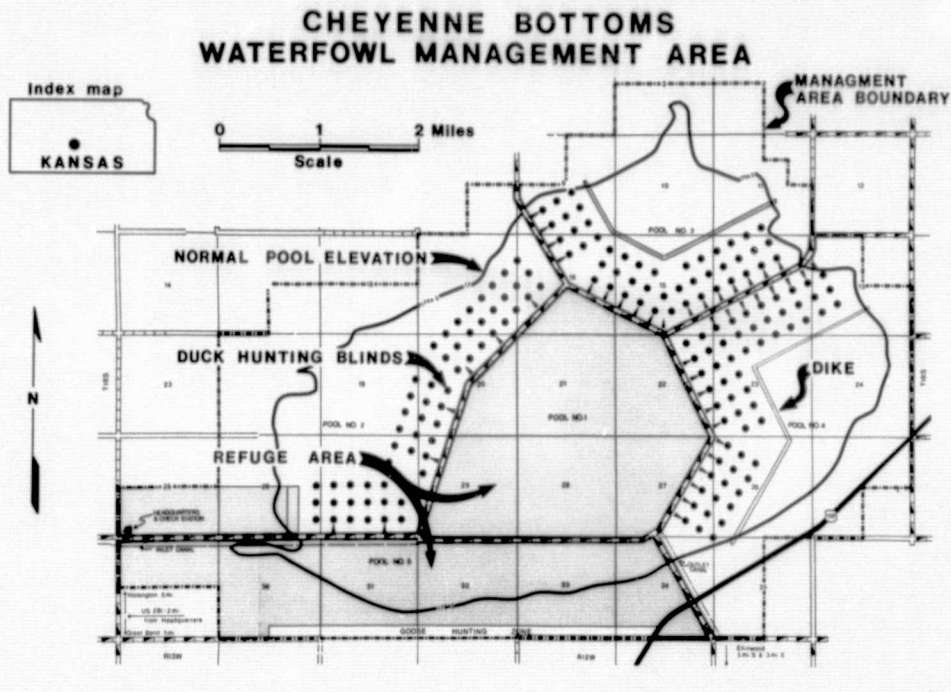


Figure 2. Dikes divide the 19,000 acre Cheyenne Bottoms WMA into five management pools.

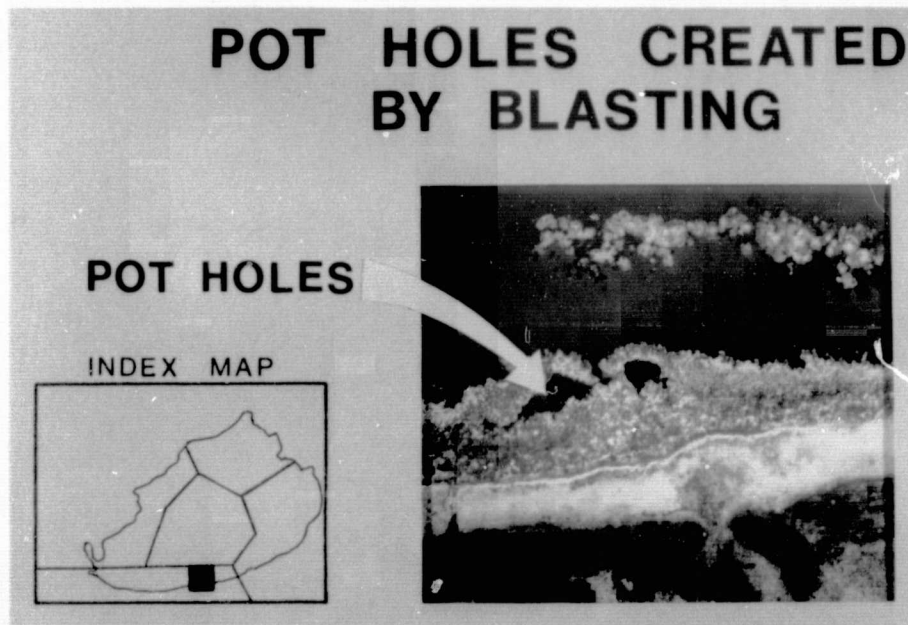


Figure 3. "Pothole" areas having good habitat interspersion were located on color infrared photos.

DETERMINING THE EFFECT OF CENTER PIVOT IRRIGATION  
ON PRAIRIE CHICKEN HABITAT IN SOUTHWEST KANSAS

Although Kansas has an abundance of game birds, a game bird of the open grasslands known as the prairie chicken or prairie grouse has received considerable attention. The recent decline of prairie chicken populations of the North American continent, has caused the U. S. Fish and Wildlife Service to seriously consider the adoption of threatened species status. Yet, Kansas has the largest prairie chicken populations of any state in the nation, and is one of only five states that allows prairie chicken hunting.

Stories of the abundance of prairie chickens in early-day Kansas rival those of the mighty buffalo herds and are based on the vast expanse of unbroken big and little bluestem prairies that provided ideal feeding and nesting conditions for the birds. As agricultural and land use changes encroached on the grasslands, the range of the prairie chickens and hence their abundances decreased.

Of particular concern are populations of the lesser prairie chicken Tympanuchus pallidicinctus in southwest Kansas where recent, dramatic increases in center pivot irrigation systems have occurred in areas that were suitable prairie habitat. The availability of center pivot irrigation systems has allowed the conversion of previously unsuitable agricultural land (prairie habitat) to productive cropland. As a result approximately 22 percent of all land annually harvested for crops in this region is now irrigated by center pivot systems. An investigation conducted in Finney County, Kansas, illustrates the rapid adoption of this innovation (Table 1).

Table 1  
GROWTH OF CENTER PIVOT IRRIGATION  
FINNEY COUNTY, KANSAS

<u>YEAR</u>	<u>NUMBER</u>	<u>ACRES</u>	<u>IMAGERY</u>
1965	11	1,760	ASCS
1971	252	40,320	ASCS
1972	338	54,080	LANDSAT
1973	459	73,440	LANDSAT
1974	590	94,400	LANDSAT

Because lesser prairie chickens only occur in very local, limited habitats in these arid regions, the irrigation increases were particularly alarming.

Suitable habitat for the lesser prairie chicken is characterized by a predominance of sandy soil and sand hill sage (Artemisia filifolia) along with mixed native prairie grasses (sand bluestem, Andropogon hallii, little bluestem, Andropogon scoparius, indian grass, Sorghastrum nutans, etc.). Increased use of the land in southwest Kansas for agriculture initially created even more optimal conditions for the prairie chicken. Correlation of game counts and habitat change by ground surveillance established a ratio of 70-60% native prairie to 30-40% irrigated agricultural land as an optimum balance.

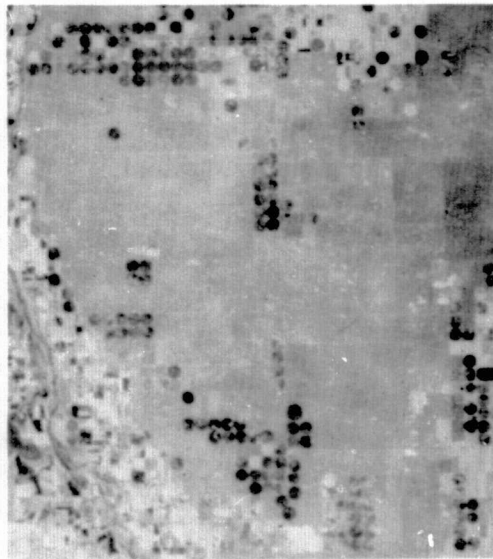
Although hard data were lacking, the increases in center pivot systems in this region gave local game managers reason to believe that optimal ratios were being exceeded in many areas. The Kansas Fish and Game (KF&G) Southwest Regional Game Manager Bill Hanzlick discussed this problem with a KARS staff member and explained the problem of monitoring the rapid increases in the number of center pivot systems. Remote sensing procedures seemed to provide a possible source of data to monitor this increase.

LANDSAT imagery of the Southwest Kansas Regional Area obtained in 1973, 1974 and 1975 was used to prepare center pivot location maps and delineate increases. Those areas where center pivot systems had replaced native prairie habitat were evident (Figure 4). Maps showing the location of center pivot irrigation systems in 14 southwest Kansas counties were provided for 1973 and 1974. Since a comparison of the maps indicated that the increases were far greater than expected, counts of the number of systems were made for 1972 from LANDSAT imagery and combined with collateral data for 1971 and 1965.

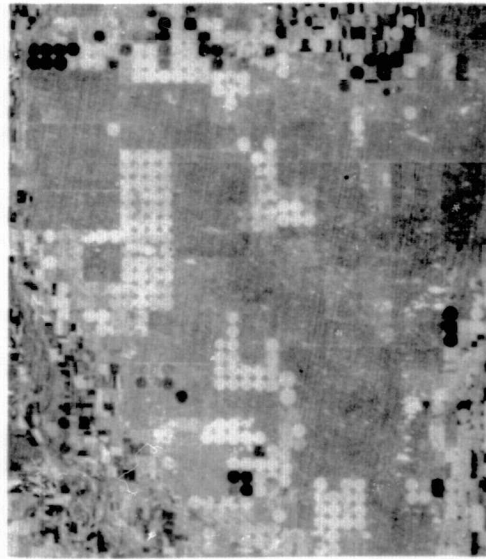
Since the results of this work left little doubt that circular irrigation had drastically influenced wildlife habitat distribution, a decision was made at the administrative level of KF&G to use these data as a basis to seek Federal funding for a research program to determine the exact distribution of native prairie and lesser prairie chicken populations in Kansas today, where decreases have occurred in the last several years and where center pivot systems will pose a future threat. Funding through June 30, 1977, for \$80,000 was obtained in February 1976, from the Pittman-Robertson Terrestrial Research Fund, U. S. Fish and Wildlife Service for this ongoing research program (Project No. W-42-R, Study No. 07).



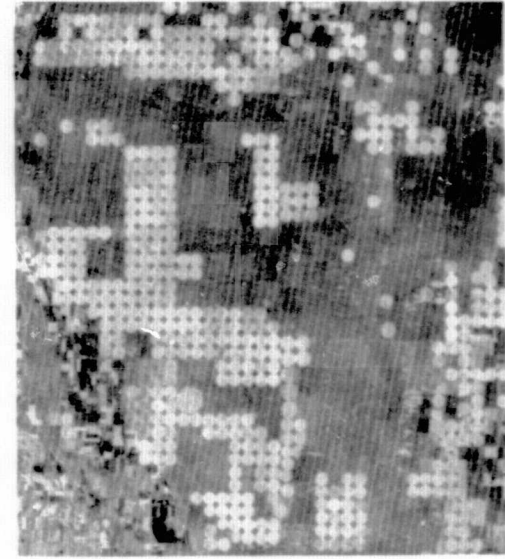
# EXPANSION OF CENTER PIVOT IRRIGATION IN SOUTHWEST KANSAS



1973



1974



1975

## LANDSAT-1 IMAGERY

Figure 4. LANDSAT imagery provides a means to monitor and map the expansion of circular center pivot irrigation as can be seen in these enlargements of portions of Finney and Kearny counties, Kansas.

*The center pivot location maps were further used to decide where to initiate Wildlife Habitat Improvement Programs (WHIP) in cooperation with landowners. To date plans for deferred grazing and reseeding of native prairie grasses have been drawn up for approximately 50 landowners and funds made available. Several landowners have incorporated their entire farms into the program. One landowner south of Holcomb, Kansas, is cooperating in the preliminary stages of a plan to set aside a 10,000 acre ranch to preserve the remaining lesser prairie chicken habitat in an area surrounded by circular irrigation systems.*

In those areas where the optimum ratio of center pivot agricultural land to native prairie has been exceeded, information on center pivot location is used by WHIP personnel for habitat reclamation. Programs are implemented to plant trees and shrubs in the corners of the center pivot area. Each of the four corners of a center pivot area then provides a seven acre area of wildlife habitat suitable for pheasants and quail.

#### Urban and Regional Analysis

##### REFUSE COLLECTION IN KANSAS CITY, KANSAS

Late in 1974 the bid for renewal of the refuse collection contract for Kansas City, Kansas, was received from the private vendor currently serving the City. The bid was unacceptably high causing the Finance Commissioner to reject the bid as was the City's option. It was decided that the City should investigate the possibility of dividing the City into smaller collection areas to allow other vendors and small minority contractors to compete for one or several areas depending on their equipment capacities. Before area divisions could be finalized it was necessary to gather the following data which was needed by the bidders for accurate cost estimates: 1) total population of each projected collection area; 2) the number of households; 3) the rate of change in the housing stock; 4) street mileage. Since the City had increased approximately 70% in size from the time of the 1970 census, the Department of Planning and Development was unable to provide the block statistics or historical data for the newly annexed area from their usual source, the building and demolition permits. The KARS Program provided remote sensing information to develop a data set compatible with

the 1970 block statistics for Kansas City for the newly annexed area.

High altitude U-2 aircraft photography for 1973 was used to acquire the necessary information. Structures were classified as single family, multi-family, commercial or manufacturing, and the numbers were tallied along each block face. These data were recorded on computer cards in a manner compatible with the existing system, then aggregated to blocks and accumulated for area divisions by the computer. From this process data sets for the annexed area indicating total population of each area, number of households, rate of housing stock change and miles of streets were provided for the City. With these data, seven refuse collection areas were delineated and superimposed on the Kansas City Map (Figure 5).

*When the existing vendor was confronted with the City's intentions and the appropriate data to support accurate bidding by new bidders, he decided to resubmit a substantially lower bid for the contract. As a result of these data, it is estimated that the City was able to realize a savings of approximately \$276,000 (Table 2). Although the City successfully negotiated a single party contract, it was decided to retain the concept of refuse collection areas for the City.*

Table 2  
REFUSE COLLECTION AND DISPOSAL COSTS  
BEFORE AND AFTER AREA DIFFERENTIATION

	<u>Old Rate</u>	<u>New Bid</u>	<u>Negotiated Results</u>
Per Residence per month	\$1.37	\$2.06	\$1.66
Total cost per year	\$945,000	\$1,421,000	<u>\$1,145,000</u>
	Saved		\$276,000

Because of the demonstrated benefits of remote sensing provided by the KARS Program, Kansas City, Kansas, has developed remote sensing facilities and capabilities to supplement their data gathering efforts to aid in decision procedures.

#### CENSUS TRACT DIVISION

The Mid-America Regional Council (MARC) is a regional planning body, consisting of elected officials from eight counties in the Kansas City Metropolitan Area (Leavenworth, Wyandotte and Johnson counties in Kansas and Jackson, Platte, Clay, Ray and Cass counties in Missouri). MARC provides a centralization of the planning function for the region and

## REFUSE COLLECTION AREAS 1975

Kansas City, Kansas

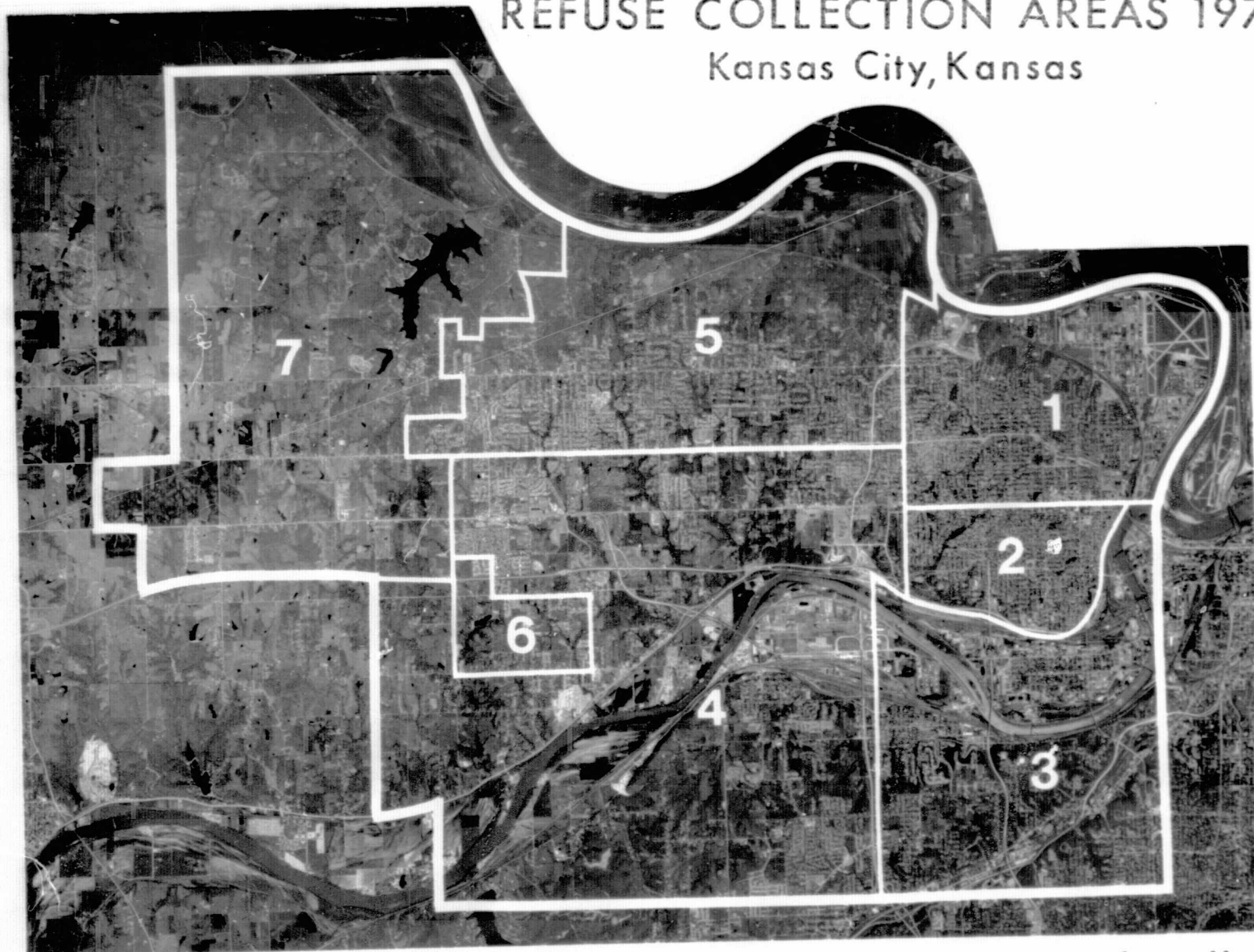


Figure 5. High altitude photography was used to acquire data needed to establish refuse collection zones in Kansas City, Kansas.

acts to coordinate the planning activities of the eight county and 109 municipal governments located within this bi-state area.

As a result of Federal mandate, MARC has recently been faced with the problem of participating in the division of eight suburban census tracts. The U. S. Bureau of the Census has issued guidelines which state that the desired population levels of any census tract should not be less 2,000 people, nor greater than 8,000. The eight census tracts had all exceeded the upper limit population levels desired by the Census Bureau and thus had to be considered for division prior to the 1980 census.

Decisions relating to this matter were to be made by the Statistical Areas Committee for the Kansas City SMSA, a committee of local citizenry charged with handling local problems associated with census gathering activities. When a census tract is considered for division, a severe data handling problem results because the data for newly created tracts must be structured and stored within the data storage system so that it may be compared with past data collected for the tract. In addition, the division itself must take into account the following considerations:

1. Population Distribution - population within the new tracts must be distributed to preclude future subdivisions of the tracts.
2. Open Space - in relation to population distribution, the distribution of open space must be considered to account for future increases in population due to expanded development.
3. Tract Homogeneity - tracts must be divided to insure that undue disruption of the cultural or physical homogeneity in the area does not occur.

The MARC advisor to the Statistical Areas Committee felt that the data derived from aerial photography would provide the committee with sufficient data on which decisions regarding division of the affected census tracts could be made. KARS personnel were asked to assist in acquisition and interpretation of high altitude (U-2) imagery for this purpose. A large scale enlargement of each census tract was made from the color infrared photography and analyzed to obtain estimates of housing density, population, open areas and other parameters specified as relevant to the division of the census tracts. This information

was used to delineate suggested new boundaries for the eight tracts. The recommended boundaries were designed to coincide with the GBF/Dime File system used by the Census Bureau. The photo enlargements for each tract with indications of new tract demarcations were delivered to the Statistical Areas Committee.

The committee utilized this data in making several census tract decisions. *It was decided that one tract would be divided according to the recommendations made by KARS personnel.* This was then sent to the Bureau of the Census for final approval. *In a second case, the aerial photography clearly indicated that the tract had reached a state of total development, with no open space remaining within tract boundaries.* However, since population within the tract was determined to have reached an equilibrium, *the Committee concluded that future fluctuations in population would likely be minimal.* It was therefore decided not to divide the tract in question. A similar decision was made concerning a third tract after it was determined that open space visible on the photography was not available to development, and that future population fluctuations within the tract would consequently be minimal. In the cases of the five other tracts, the committee chose to make use of conventionally acquired data in their decision-making process. Nevertheless, details of the remote sensing procedures used were later forwarded to the Census Bureau by MARC officials as a demonstration of what they considered to be an innovative mechanism for dealing with this particular census related problem.

### Agricultural and Rural Analysis

#### REPUBLICAN RIVER CANOE TRAIL AND CAMPSITE DECISIONS

Natural resource and recreational development are two of the major objectives of the eight county Four Rivers Resource, Conservation and Development (RC&D) Project in north central Kansas. These goals were set to counteract economic losses from declining rural populations and the lack of suitable recreational facilities in the area. To aid in this development, the Kansas Park and Resources Authority prepared an Outdoor Recreation Plan for northwest Kansas, which included the establishment of a canoe trail and campsites on the Republican River in Cloud county

between Concordia and Clyde, Kansas, a distance of 22.7 miles. Although the proposal was well received, in late fall 1973 flooding destroyed several of the proposed campsites and held up implementation of the recreational program. In May 1975, KARS personnel met with James Habiger, Four Rivers RC&D Project Coordinator, and Norman Christian, an official of the Concordia Chamber of Commerce, to discuss the possibilities of using remote sensing to update the State Park and Resource Authority's plan and assist in determining the continued viability of a canoe trail.

Subsequently, a map and other data were provided by the KARS Program. The map, a portion of which is shown in Figure 6, helped build interest in the program and provided updated information for development of the canoe trail and campsites. Large scale black and white panchromatic aerial photography flown by the U. S. Army Corps of Engineers in spring 1974 was compared with 1971 Agricultural Stabilization and Conservation Service (ASCS) photography and used to delineate those campsites proposed by the State Park and Resource Authority that had been inundated by the flood. Remote sensing data provided a rapid evaluation of the relative stability and quality of the remaining campsites. The remote sensing analysis verified that 9 out of 23 proposed campsites between Concordia and Clyde were destroyed. Campsite stability, access, landscape quality, and large sand beaches for swimming areas were delineated from the remote sensing data and used in selecting optimum campsites. The locations of access roads near the campsites were indicated on the map and provided the information needed to obtain easements.

*County officials and the local Concordia Chamber of Commerce have now decided to give the program their full approval and have shown their support by preparing a brochure (Appendix II) designating campsites and access roads along the canoe trail.* Facilities at the campsites will include picnic tables, litter barrels, fire pits and portable restrooms. RC&D and county officials are now encouraging local and state agencies to use similar remote sensing data for establishment of canoe trails and campsites along the remaining 54.7 miles of the Republican River in Republic and Jewell Counties.



## REPUBLICAN RIVER CANOE TRAIL AND CAMPSITES

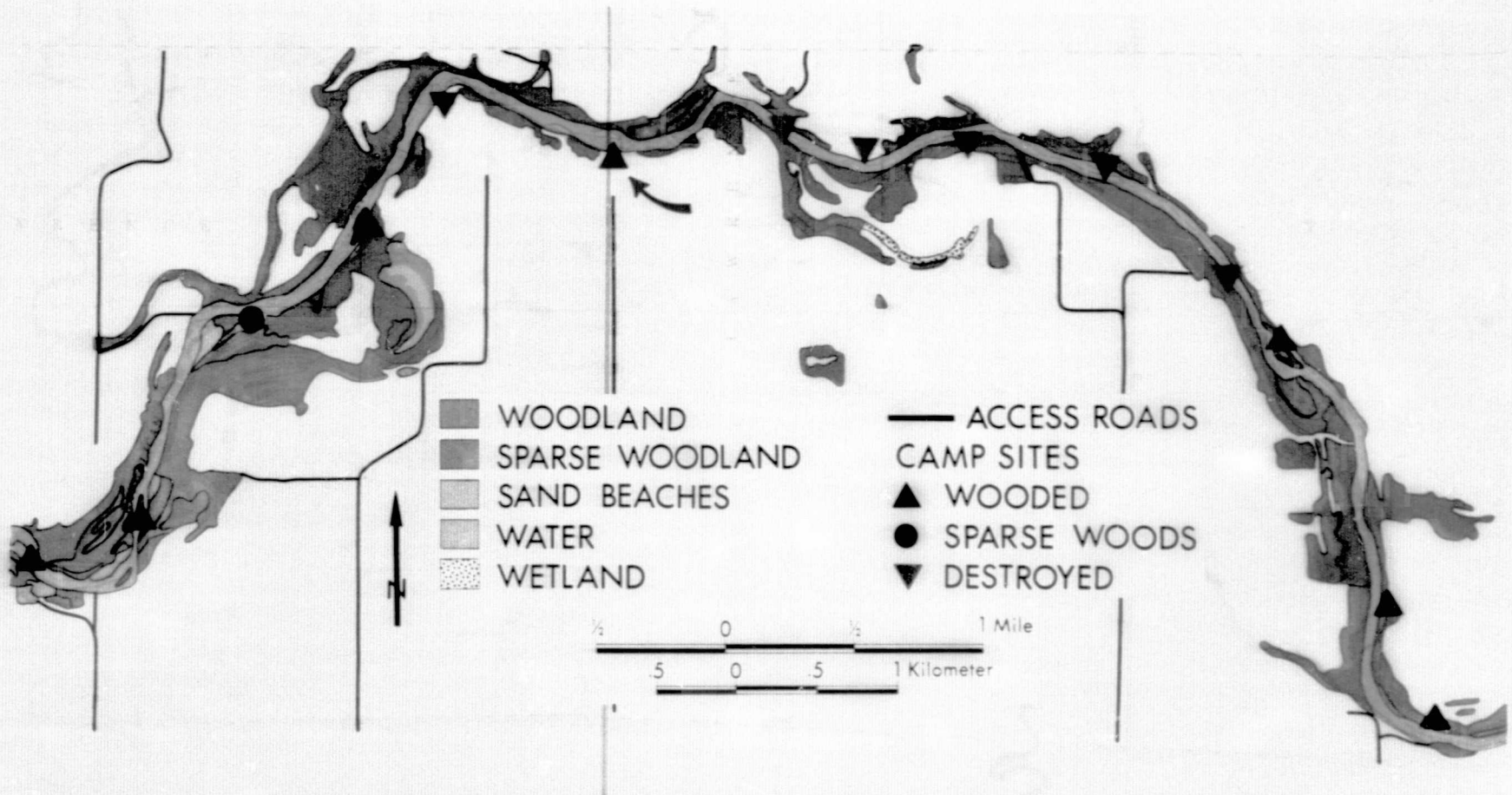


Figure 6. Following flooding in 1973, large scale aerial photographs were used to evaluate access, relative stability, and quality of campsites along the Republican River Canoe Trail.



## DECISION ON COUNTY LINE LAKE, MISSOURI

In March 1975, KARS personnel were contacted by representatives of the Missouri Department of Natural Resources and the Missouri Governor's office concerning the feasibility of obtaining land resource data for an area proposed for inundation by County Line Lake, 13 miles east of Springfield in Webster and Greene counties, Missouri. The Missouri officials were aware of the previous work accomplished by the KARS Program on the Pattonsburg Lake project. Information similar to that collected for the proposed Pattonsburg Reservoir was required for the smaller County Line Lake, but on a much faster turn around. The state officials requested that a detailed land use/land cover map and areal statistics for each type of land within the floodpool be compiled by May 1975. The data were to be used to assist in deciding whether or not to allocate state financial aid for the proposed reservoir.

The State of Missouri provided the major portion of the costs involved in obtaining the commercially acquired aerial photography, and performing interpretative and other analyses. The work accomplished by KARS personnel was designed to provide an evaluation of the types and amounts of land use within the conservation pool of the reservoir. The nature of the topography and the modest difference (10 feet) in elevation between the conservation and floodpools of the reservoir resulted in little areal difference between the two pools. The analysis and accompanying map were restricted to the area of the conservation pool. This area was determined from available topographic maps (scale 1:62,500) using the conservation pool elevation of 1,334 feet. Location of the pool was based on interpolation between the 1,320 and 1,340 foot contours on the topographic maps.

Analysis was based on interpretation of aerial photography acquired 4 April 1975. This conventional color photography (Kodak Film No. 2448) was acquired in 9.5 inch format between 12:00 and 1:00 p.m. on that date. The scale of the original photography was 1:20,000 nominal. Acquisition was under cloud free, clear terrain conditions and provided complete stereoscopic coverage of the proposed reservoir area.

Interpretation was conducted on the original film positives. Boundaries of each mapping unit were traced on a transparent overlay of each frame and the content of the unit was identified as described below.

Each frame was analyzed by one interpreter and checked by another interpreter. The individual overlays, each covering an area of about 4 square miles, were then fitted together and those mapping units within the conservation pool were traced to a common base at a scale of 1:20,000 (3.125 inches equal 1 mile).

The categories mapped (Figure 7) were as follows:

Cropland - all fields which had been cultivated that spring, still retained stubble from corn produced last year, or contained wheat that spring.

Other cultivated land - fields which were planted to clover, had been newly planted to grass that spring, or contained weeds rather than grass. All such fields exhibited cultivation patterns of the type evident on the cropland which were different from those associated with pasture improvements.

Pasture - all areas of native and planted grasses used for the grazing of cattle.

Forest - areas with an apparent closed canopy of trees.

Farmsteads - groups of buildings which appeared to contain an occupied house and other structures (such as barns) associated with operation of a farm.

Other dwellings - apparently occupied houses which were not colocated with structures associated with farm operation.

Other structures - buildings or groups of buildings, generally associated with farming, not colocated with an apparently occupied house.

Cemetery - area indicated on the photography by the presence of gravestones.

After the preliminary interpretation had been conducted, field checking was accomplished by a windshield survey of 22 April 1975. This survey involved driving along all asphalt and gravel roads and annotating the overlays to verify or alter the interpretations as necessary. The majority of mapping units were inspected by this process. Identification of other mapping units was based on their similar appearance on the photography to units seen in the field.

Each mapping unit was then measured with a Hewlett-Packard digitizer. This device measures the area enclosed by a line which has been traced

with a cursor. The areas of each mapping unit were summed to obtain the acreage of each class on the map. (The methods of interpretation and measurement used in this project should result in assignment of mapping units and acreage determinations which are within  $\pm 5$  percent of their true value.) The map was then reduced from its original scale of 1:20,000 during drafting and reproduction to the scale of 1:25,000.

The area of each category was determined to be as follows:

<u>Land Use</u>	<u>Area (Acres)</u>
Cropland	562
Other cultivated land	546
Pasture	3,180
Forest	1,354
Other land (farmsteads, other dwell- ings, other structures and cemetery)	<u>141</u>
Total	5,783

The data were provided to the Governor's Task Force by May 1, approximately six weeks after the KARS program was initially contacted to obtain the remote sensing data. Additional data forwarded to Missouri officials included information on access, mileages of various road types, and counts of structures.

The map and data compiled by KARS personnel were used in the evaluation of the project by the staff of the Missouri Department of Natural Resources. *In June 1975, the Newsletter of the Missouri Department of Natural Resources reported that Governor Christopher S. Bond would not appropriate the approximately \$7 million requested state commitment for the recreational aspects of the lake because of the state's financial condition at the time.* The Governor suggested that Springfield and/or Green County might provide the non-federal costs if they desire. The Governor further called on the Corps of Engineers, the construction agency, to provide a more detailed analysis. Furthermore, he recommended additional time for a review of the proposed County Line Lake in order to give Springfield an opportunity to consider their participation in funding the non-federal costs of the project and for an in-depth review of alternatives to Springfield's water supply needs.

The data obtained from aerial imagery by KARS Program personnel contributed significantly to these decisions.

PROPOSED  
COUNTY LINE LAKE  
WEBSTER COUNTY, MISSOURI

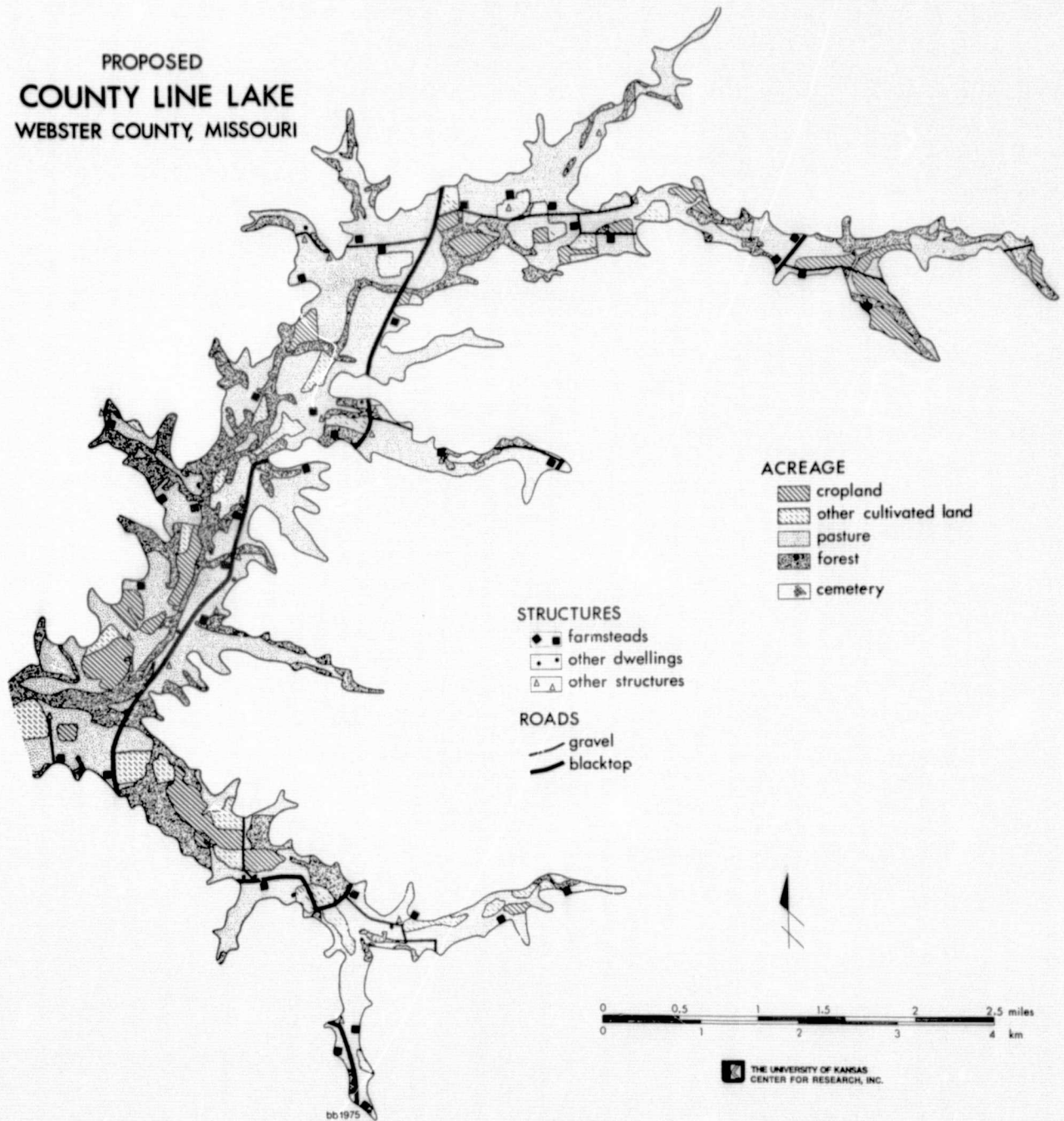


Figure 7. A land use map of the area to be inundated by the proposed County Line Lake was compiled from large scale conventional color aerial photography.

## B. PROJECTS AWAITING DECISIONS

During the past year a number of projects have been completed by KARS staff and are now awaiting agency decisions or further action. They are discussed below.

### Wildlife Habitat and Environmental Analysis

#### MAPPING AQUATIC VEGETATION AT DOUGLAS COUNTY STATE FISHING LAKE

Following a June 1971 fish population inventory of Douglas County State Fishing Lake, Kansas Forestry, Fish and Game (KFF&G) personnel discovered a slow growth problem with populations of largemouth bass, the major game fish in this lake. Since the largemouth bass feeds primarily on the bluegill fish, an investigation of this link in the food chain was initiated. The lack of available forage (bluegill) for predation by largemouth bass is thought to be caused by extensive vegetation in the lake. The bass are unable to navigate the dense growths in pursuit of prey (bluegill) and the bluegill are stunted in reproduction by the vegetation.

Chemical treatment which involved mixing of the herbicides into the water on several occasions in successive years has been ineffective in controlling or reducing the extent or effect of the vegetation. For this reason a new course of action was sought which would place emphasis on remedy of the cause rather than temporary measures taken on the effects.

The aquatic vegetation (mostly Chara) is found in the trophogenic layer (superficial growth layer) of the lake. Its growth is limited to areas no deeper than about seven feet because the available light is reduced by turbidity, color, scattering, and attenuation to a level of energy which is insufficient to sustain growth and development of the plants at greater depths. This light limiting depth is controlled by shore terrace development and the slope away from the water edge. It was therefore suspected that in areas where shallow waters exist, the vegetation would be found growing in abundance. In order to alleviate the problem, KFF&G would have to draw down the lake level sufficiently to dry out the shore terrace and allow the movement of heavy equipment to

deepen the shore zone. In order to make the decision to commit time, funds and cause a disruption of public activities at the lake it was necessary for KFF&G to know the extent of the aquatic vegetation and its actual relationship to the shore terrace.

A flight was made during the height of vegetation growth in mid-summer. On 22 August 1975, the Space Technology Center Cessna 180 aircraft, equipped with four Hasselblad 500 EL 70 mm format cameras, imaged the lake at an altitude of 3,000' AGL (above ground level).

The cameras were loaded with four film/filter combinations (natural color, skylight; color infrared, blue; Color SO-397, light yellow; black and white panchromatic, skylight). Original image scale was 1:9144. The natural color film was determined to be most appropriate for this type of data gathering. A Bausch & Lomb Zoom Transfer Scope was then used to produce a map of aquatic vegetation. This map was superimposed on a portion of the lake surveyor's contour map to achieve the resultant final map which included contours at seven and fifteen feet of water depth (Figure 8). Area measurements were made on the digital plotting surface of an attachment to a Hewlett-Packard 9100B program-mable calculator using an enclosed area program. Examination of these (Table 3) shows the relationship of aquatic vegetation to the shore terrace.

From this information it is expected that KFF&G will be able to make its decision concerning a course of management for this lake. Furthermore, the agency has expressed interest in using remote sensing techniques on similarly affected water bodies in other parts of Kansas.

#### DELINEATION OF DRAINAGE PATTERNS IN STRIP MINED AREAS OF SOUTHEAST KANSAS

Strip mining has been employed in the extraction of coal in southeast Kansas for over sixty years. Environmental effects continue to be evident even though several of the largest coal companies ceased operations in the late 1960's. Of particular concern is the seepage of water through mine wastes on disturbed land. State and local officials working on environmental quality matters wish to determine the extent to which this seepage is contributing to pollution of streams and lakes, particularly in Crawford and Cherokee counties. Agencies working on problems related

# AQUATIC VEGETATION IN DOUGLAS COUNTY LAKE

22 AUGUST 1975

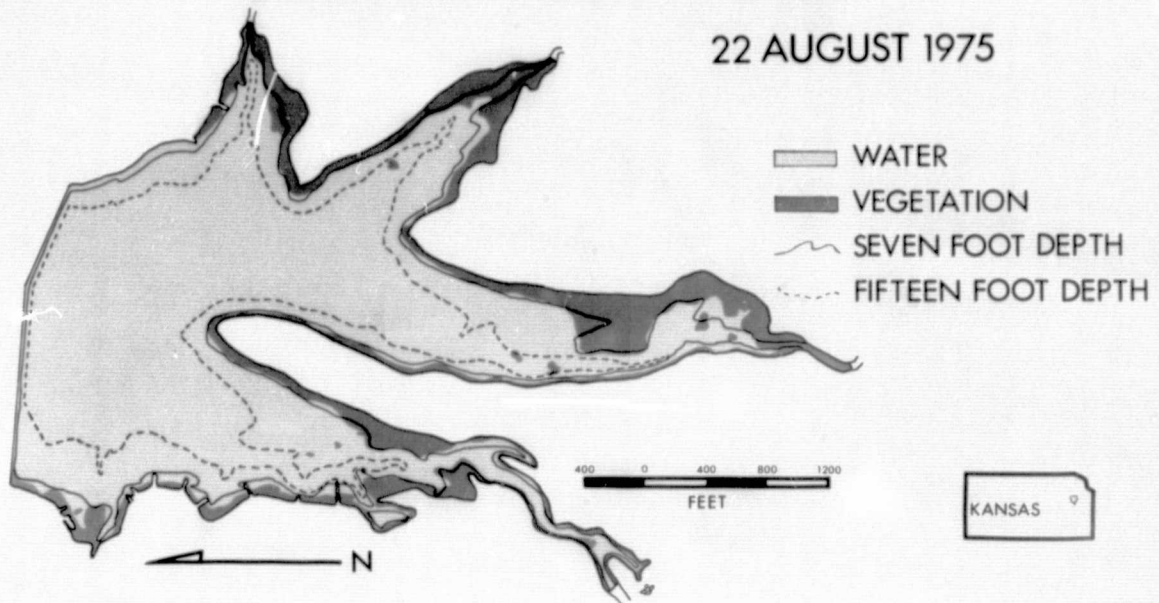


Figure 8. Large scale natural color aerial photos were used to map aquatic vegetation in Douglas County State Lake .

TABLE 3  
AREA MEASUREMENTS FOR DOUGLAS COUNTY LAKE  
22 AUGUST 1975

<u>AREAS</u>	<u>ACRES</u>	<u>% TOTAL</u>
Water	184	100
Vegetation	36	19
7' Contour to Shoreline	44	24
15' Contour to Shoreline	102	55

Vegetation covers 82% of the area between the 7' depth contour and the shoreline and 35% of the area between the 15' depth contour and the shoreline.



to strip mining in this region include the Kansas Forestry, Fish and Game Commission (KFF&G), the Kansas Attorney General's office, and the Kansas Department of Health and Environment.

During the past year KARS personnel met with Mr. John Ray, KFF&G Regional Fisheries Biologist in southeast Kansas to discuss problems in obtaining information related to the existing drainage patterns on an area of strip mined land in northwest Cherokee County. The mining has dramatically disrupted the natural drainage within the area to the extent that available topographic maps did not accurately portray the pattern. The drainage data are needed by KFF&G to help them in effectively locating water quality monitoring stations. Data derived from these stations will be used to determine the suitability of streams for fish stocking programs.

KARS personnel used 1973 high altitude (U-2) color infrared aerial photography to map existing drainage patterns. Figure 9 illustrates a sample of this imagery (reproduced in black and white) and a corresponding section of the drainage map. *Using this map, KFF&G biologists were able to decide upon the locations of 14 monitoring stations.*

Recently the State Department of Health and Environment and the State Attorney General's office have also expressed interest in using the maps. Particular interest is focussed on possible pollution of the water supplies of several towns in Kansas and Oklahoma. Legal action against coal companies which have inadequately treated reclaimed land could result.

### Urban and Regional Analysis

#### MAPPING URBAN EXPANSION ON PRIME AGRICULTURAL LANDS

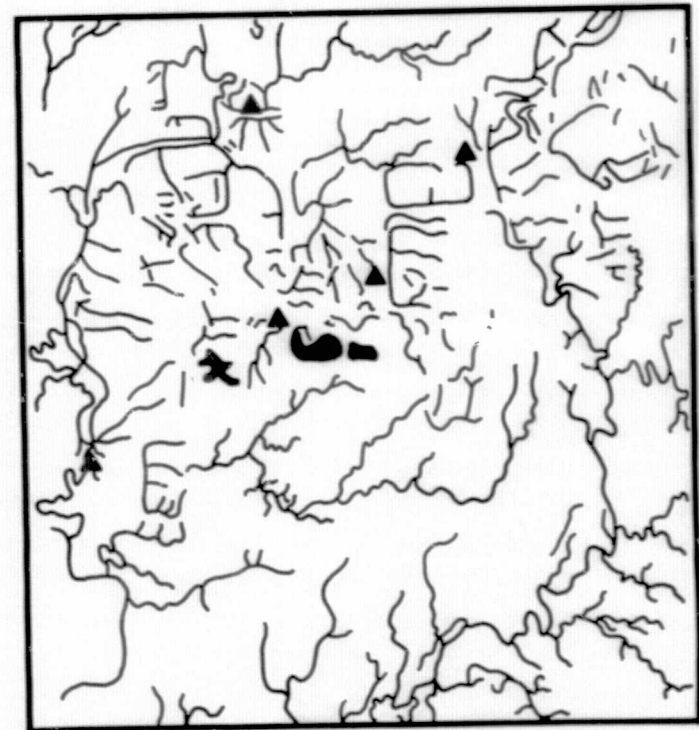
The Mid-America Regional Council (MARC) is an eight county regional planning agency which includes three Kansas and five Missouri counties in the Kansas City metropolitan area. During 1975 MARC officials agreed to cost share with the KARS program on a study of the extent of urbanization in the region. It was felt that this type of study was needed to aid MARC in determining the degree to which urban development was affecting the region's prime agricultural land resources and in determining the future effects which additional expansion might have.



# MAPPING DRAINAGE IN STRIP MINED AREAS CHEROKEE COUNTY, KANSAS



High Altitude Photo-1973



— Drainage Channels

▲ Water Quality Sampling Stations

Figure 9. A drainage map of strip mined areas in Cherokee County, Kansas, prepared from high altitude aerial photography, has aided water quality analysts in deciding upon locations for water quality monitoring stations.

This information would allow them to assess the current situation and provide them with a base upon which they could evaluate the future planning requirements of the region with respect to this problem.

In 1974, an extensive soil survey had been completed for the region as a part of the National Cooperative Soil Survey Program. One of the products of this survey was a map which delineated prime agricultural land resources in the region based upon soil, landscape and slope characteristics. MARC officials wished to compare this map with data on the extent and rate of urbanization, the latter to be obtained from aerial photography. The imagery used in the study consisted of high altitude color infrared aerial photography acquired over the region in October 1969 and May 1974.

A 1:125,000 scale county road map was used as the base map for each county. The 1969 imagery was interpreted and mapped first, followed by mapping of the urban area as it appeared in 1974. Comparison of the two maps showed where new urban areas had appeared. In both 1969 and 1974, the high altitude imagery covered only a portion of the region; consequently, additional imagery was utilized to complete the interpretation for portions of the most rural counties. The 1969 imagery was supplemented by ASCS photography acquired in 1970 for a portion of Ray county. The 1974 imagery was supplemented with a second high altitude flight which had been acquired in 1975 and which covered the easternmost portion of the region.

The urbanized areas map was compared to the prime agricultural land map to determine those areas where urban development and prime agricultural land were in conflict. (Figure 10) During the five year period a total of 27,598 acres of new development was detected, which brought the amount of urban development within the region to 11% of the total land area. Forty two percent of this new development (11,682 acres) had occurred on prime agricultural land. Prior to 1969, only 35% of the urban development was on prime agricultural land.

In this study, remote sensing offered unique data unavailable from other more conventional sources. MARC officials will use the resulting maps and statistical data in decisions related to future urban land development in the Kansas City region.

# URBAN EXPANSION ON PRIME AGRICULTURAL LAND OLATHE, KANSAS



1969



1974

High Altitude CIR Photos



- Urbanized Area 1969
- Expansion 1969-1974
- Prime Agricultural Land

Figure 10. High altitude aerial photographs taken five years apart were used to assess the extent to which urban land uses are encroaching upon prime agricultural land in the Kansas City Metropolitan region.

## Agricultural and Rural Analysis

### INVESTIGATION OF CHANGES IN RANGELAND QUALITY BARBER COUNTY, KANSAS

Western Barber County, Kansas, is a region of native mid-grass prairie utilized primarily for cattle grazing. Cropland development of the region has been limited to floodplains of the larger streams and some flat upland areas because of the rough topography and shallow soils found in large sections of the county. Of the total area of the county 61% of is in grassland, most of which is concentrated in the western portion of the county. Because of the dominance of this land cover and land use, the quality of the grassland is an important economic factor to the people of the county.

Barber County falls within the jurisdiction of the Sunflower Resource Conservation and Development (RC&D) Project. The Kansas Applied Remote Sensing Program is working with this RC&D Project, the U. S. Soil Conservation Service (SCS), and the Barber County Conservation District to develop an evaluation of changes in rangeland condition that have occurred during the last 25 years. An evaluation has become necessary since it appears that several species of woody plants, unpallatable to cattle, have invaded the grassland areas and have reduced the overall quality of the rangeland. Barber County was specifically selected for study because it seems to be the area within the Sunflower RC&D which is having the greatest problem with this type of rangeland deterioration. With the proper data SCS, RC&D and Conservation District personnel will be able to determine the extent of invasion and distribution of woody species on rangeland. The main woody species of concern are: (1) Eastern red cedar (Juniperus virginiana) and (2) Sand sagebrush (Artemisia filifolia). This evaluation will lead to decisions regarding the control measures needed to minimize the effect of invasion of woody plant species. Because financial resources are limited, an additional decision will be made on where to concentrate control efforts.

Maps showing the distribution and extent of the woody species and rangeland condition as they existed in 1950 have been developed. By comparing these maps with maps showing the distribution of the same features in 1973 an accurate evaluation of change in the amount of land

covered by the different species can be obtained. The maps will also show the geographic locations where the greatest change has occurred and where the greatest concentration of problem species exists.

The maps of rangeland condition and woody plant species distribution as they existed in 1950 were made by interpreting ASCS black and white panchromatic aerial photography (scale 1:20,000) flown in 1950. The interpreted data were reduced to a scale of 1:125,000 in order to fit the county base map. A variety of types of imagery were used to develop the map showing the distribution of woody plant species and rangeland conditions as of 1973. The imagery types used were: (1) LANDSAT false color composites (2) Skylab S190B photography and (3) NASA aircraft Skylab underflights. Data from these sources were also mapped at a scale of 1:125,000. Analysis of the two maps is now underway by range managers.

Several other agencies have shown interest in the Barber County project. The invasion of red cedar onto rangeland has proven to be a vexing problem in other areas of Kansas. The Kansas Department of Agriculture, Weed and Pesticide Division, is interested in the problem and has requested data on two additional counties. The 1973 vegetation map of Barber County may also help Kansas Forestry, Fish and Game personnel to make a decision whether or not to locate mule deer in the region.

**APPENDIX I**  
***KARS NEWSLETTER(s)***



# Kansas Applied Remote Sensing



**Newsletter**  
Volume 5, Number 1  
January 1976

## SHORT COURSE ON REMOTE SENSING/ AERIAL PHOTO INTERPRETATION- TERRAIN ANALYSIS

Openings are still available for the forthcoming short course on Remote Sensing/Aerial Photo Interpretation and Terrain Analysis to be offered March 15-19, 1976 at the KU Space Technology Center. Instructor for the course will be Douglas S. Way, Professor in the Graduate School of Design at Harvard University. The \$225.00 tuition fee includes a copy of the course text, several publications and a stereoscope. The course will be accredited by the Continuing Education Program of the Harvard University Graduate School of Design. A pamphlet offering additional details may be obtained by contacting either Glenn Sheppard or Ms. Pat Nicholas.

## REMOTE SENSING ASSISTS KANSAS DECISION-MAKERS IN 1975

The University of Kansas Applied Remote Sensing (KARS) program is funded by the National Aeronautics and Space Administration (NASA) Office of University Affairs to assist decision makers in local, state and regional agencies in the application of remote sensing techniques to their problems and activities. During 1975 KARS personnel worked cooperatively with a number of agencies to aid various officials in utilizing remote sensing data. These projects included the following:

## REFUSE COLLECTION IN KANSAS CITY, KANSAS

Late in 1974 the annual bid for renewal of the refuse collection contract for Kansas City, Kansas was received. The bid was unacceptably high, causing the Finance Commissioner to reject it as was the city's option. A study was initiated to investigate the possibility of dividing the city into smaller collection areas to allow other vendors and small minority contractors to compete for one or several areas depending on their equipment capacities. Before area division could be finalized it was necessary to gather the following data which was needed by the bidders for accurate cost estimates: 1) total population of each projected collection area; 2) the number of households; 3) the rate of change in the housing stock; 4) street mileage. Since the city had increased approximately 70% in size from the time of the 1970 census, the Department of Planning and Development was unable to provide the block statistics or historical data for the newly annexed area from their usual source, the building and demolition permits. The KARS Program provided remote sensing information to develop a data set for the newly annexed area compatible with the 1970 block statistics for Kansas City.

1973 high altitude U-2 aircraft photography was used to acquire the necessary information. Structures were classified as single family, multi-family, commercial, or manufacturing, and the numbers were tallied along each block face. These data were aggregated to blocks and accumulated for area divisions. Data sets for the annexed area indicating total population of each area, number of households, rate of housing stock change and miles of streets were provided for the city.

## KANSAS REMOTE SENSING HANDBOOK SET FOR SPRING PUBLICATION

As noted in the last issue of the KARS Newsletter, KARS Project staff members are engaged in compiling a handbook and directory of remotely sensed data of Kansas. As a result of a decision made to modify certain aspects of the handbook's content and format, the publication is now expected to go to press in March 1976 and will be available for distribution shortly thereafter.

The directory will include information on various types and scales of imagery, maps of coverage and details on the means to order aerial photography, LANDSAT imagery, and other data. In order that the handbook may be as complete as possible, agencies or business concerns possessing aerial photography or other types of remotely sensed data which can be obtained by the public are requested to contact Tim Traylor or Joe Poracsky at the KU Space Technology Center.

The Kansas Applied Remote Sensing Newsletter is published in January, April, July and October by the University of Kansas Applied Remote Sensing (KARS) Program with facilities located in the Space Technology Center, Nichols Hall of the University of Kansas. The Newsletter is made possible through NASA Office of University Affairs Grant No. NGL 17-004-024. Contributions of research findings, announcements of meetings, publications, and information pertinent to remote sensing applications in Kansas or the Mid-West/Great Plains region are encouraged. Inquiries and contributions should be addressed to Pat Nicholas, Editor, KARS Newsletter.

Persons working in Kansas who believe that they may be able to use remote sensing in a decision-making capacity are invited to contact the KARS Program at the University of Kansas. Address all inquiries on specific projects to the person(s) indicated in c/o:

KU Space Technology Center  
Raymond Nichols Hall  
2291 Irving Hill Drive - Campus West  
Lawrence, Kansas 66045

or telephone:

913/864-4775.

(except as noted)

The University of Kansas Center for Research, Inc.  
KARS Newsletter  
2291 Irving Hill Drive - Campus West  
Lawrence, Kansas 66045



# Kansas Applied Remote Sensing

# KARS

Volume 5, Number 2

April 1976

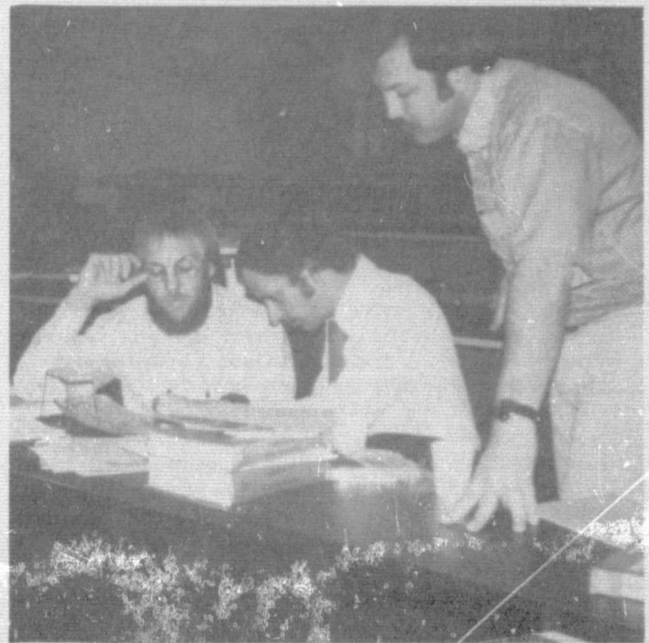
## Newsletter

### SHORT COURSE EXAMINES USES OF REMOTE SENSING IN TERRAIN ANALYSIS

During the week of March 15-19 the KARS Program was the sponsor of a short course conducted by Douglas S. Way, Associate Professor in the Harvard University Graduate School of Design. Participants having a wide variety of interests (government, university, private, corporate); backgrounds (geology, geography, engineering, transportation); and from a number of localities (New Jersey, Florida, Oklahoma, Kansas) studied methods of site evaluation using aerial imagery.

The course emphasized procedures that can be followed to facilitate acquisition of information through remote sensing and/or aerial photographic interpretation techniques to arrive at efficient, effective decisions concerning problems associated with development of inherent site features. Topics covered included image interpretation of landforms, geologic features, soils, vegetation, and land use. Methods for estimating depth of soil to bedrock, and depth to water table using aerial imagery were also examined. Though the course focussed upon the utilization of large scale aerial photography, the uses of other sensors including LANDSAT and Skylab were also reviewed.

Professor Way adopted a problem oriented teaching approach considered very beneficial by the attendees in providing experience with actual problem situa-



Professor Douglas Way (center) discusses interpretation problems with Mr. Hilbert, Kansas Department of Agriculture, (left) and Dr. Edward Martinko, KARS Project Coordinator.

tions. In addition, lectures dealt with a broad spectrum of topics for effective employment of remote sensing techniques.

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## RECONNAISSANCE LAND USE MAP OF SUMNER COUNTY

Sumner County, Kansas is experiencing considerable loss of agricultural land to the "sprawl" of urban development and accelerated growth of rural homes and recreational sites. Much of this growth is occurring in the northern reaches of the county in response to pressures from the urbanized area of Wichita. The Chikaskia, Golden Belt, and Indian Hills Regional Planning Commission has been assisting the Sumner County Planning Board in preparing to deal with future development. It is the intent of the county to establish zones for this development along with necessary regulations.

KARS program personnel were recently requested to work with Regional Planning Commission staff member, Ms. Jo Jones, in preparing a map of existing county land use patterns. The regional planners required a comprehensive map in a short period of time. During March 1976, the KARS staff mapped woodland, rangeland, cropland, and urban and builtup areas of Sumner County. The data was interpreted from 1973 Skylab natural color photography and was checked and corrected against 1975 LANDSAT imagery. The map was registered as an overlay to the 1:125,000 county highway map. A compilation copy of the land use map was prepared and forwarded to the Regional Planning Commission within approximately 14 days of the initial request.  
(J. Merchant)

## THE FOUR RIVERS RC&D RANGELAND MANAGEMENT STUDY

The Four Rivers Resource Conservation and Development (RC&D) district, comprised of Jewell, Republic, Mitchell, Cloud, Lincoln, Ottawa, Ellsworth and Saline Counties, includes approximately 1,000,000 acres of grassland of which more than 50% or 628,490 acres is in need of conservation treatment. It has been estimated that more effective management could produce economic benefits in excess of 10 million dollars annually. The development of an accelerated conservation and management program requires an accurate base of resource data. This data needs to include items such as total rangeland area, an accurate evaluation of range condition, isolation of overgrazed areas, as well as areas being effectively managed, and the current trends of resource conditions. From this type of data decisions can be made regarding distribution and intensity of technical assistance, impacts of projected improvement, both economically and environmentally, and more effective information programs with landowners.

KARS Program personnel will employ LANDSAT 1 and 2 imagery to define range plant vigor conditions in rangeland areas. This information will assist the area Range Conservationist, Mr. Ken Hladek, in deciding which areas should be grazed, which areas should be burned to increase grass productivity, and how much funding should be allocated for technical assistance and reseeding programs in certain counties. An initial demonstration study will begin in early April in Lincoln, Ellsworth and Saline counties. If this technique proves beneficial in these counties and can be adequately developed, a broader program will be implemented.

(Ted Talmon)

## WILDLIFE HABITAT INVESTIGATIONS AT NORTON RESERVOIR

KARS Program personnel are initiating a study of the vegetation surrounding Norton Reservoir near Norton, Kansas. The project, being undertaken with cooperation of the Kansas Forestry, Fish and Game Commission, will utilize low altitude, large scale aerial photography to determine the areal extent and interspersions of habitat types. An overflight of the reservoir has been scheduled for April 1976. This information will be supplied to KFF&G in the form of a map and table indicating areal coverage of vegetation types in relation to the lake pool level on the date of the photographic coverage. It is expected that this information will assist KFF&G personnel in making decisions on the introduction of game fish into the reservoir during periods of higher pool elevation, and in better managing game bird populations when the pool level is low.

(Glenn Sheppard)

## KARS PROGRAM 1976

*The University of Kansas Applied Remote Sensing (KARS) program is funded by the National Aeronautics and Space Administration (NASA) Office of University Affairs to assist decision makers in local, state and regional agencies in the application of remote sensing techniques to their problems and activities. Persons working in Kansas who believe that they may be able to use remote sensing in a decision-making capacity are invited to contact the KARS Program at the University of Kansas in o/o:*

*Space Technology Center  
University of Kansas  
Lawrence, Kansas 66045*

*913/864-4775 or KANS-A-N 564-4775*



## DOUGLAS COUNTY LAND USE MAPPING

The Douglas County Commission has contracted with the KARS program to provide an updated land use map for the county. Mapping will be done using both high altitude and low altitude aerial photography. The map will replace similar products provided to the county previously by personnel from the Space Technology Center.

Mapping will be accomplished in two phases, with the first phase involving the compilation of a generalized land use map based upon existing high altitude small scale imagery. It is anticipated that this initial work will be completed by early May 1976.

Following the completion of the generalized map, a comprehensive detailed mapping effort will be undertaken. This second phase will utilize low altitude imagery which is being flown by the Space Technology Center. All products will be provided at a 1:24,000 scale to register with USGS topographic maps.

(Ron Shaklee)

## AUTOMATED ANALYSIS OF WILDLIFE HABITAT

The Kansas Forestry, Fish and Game Commission has recently completed a research contract with Bendix Aerospace Corporation, Ann Arbor, Michigan under which the capabilities of automated techniques to analyze LANDSAT digital data were investigated. This project was a continuation of efforts to determine a cost and time effective technique to monitor changes in land use affecting wildlife habitat. The investigation covered approximately 13,600 square miles in northeast Kansas. The time of year selected for study (May 5, 1974) was chosen primarily to maximize the differences that occur in the growth rates of warm season and cool season grasses, and to provide data on cropland, woodland and water.

The results show promise for use of this technique in measuring certain parameters of wildlife habitat. As expected, some problems were encountered during this initial effort. Accuracy of interpretation of certain categories for example, was somewhat less than optimal. Closer examination of the data indicated the probability of obtaining much higher accuracies by using collateral information to select more effective training areas and dates of imagery that would help avoid problem areas. More detailed information on the results of this study can be obtained by contacting Bruce Waddell, Kansas Forestry, Fish and Game Commission, Box 88, Valley Falls, Kansas 66088.

## MAPPING THE DISTRIBUTION OF EASTERN REDCEDAR IN POTTAWATOMIE COUNTY 1950 AND 1973

In recent years, ranchers in many areas of Kansas have become increasingly concerned over the growing problem of infestation of rangeland with woody vegetation, especially Eastern Redcedar. These plants are unpalatable to cattle and are apparently becoming more widespread. Responding to this issue, the Kansas State Department of Agriculture, Weed and Pesticide Division, has requested that KARS Program personnel assist in evaluating the magnitude and extent of the problem in two sample counties. The information derived from these studies will be used by Weed and Pesticide Division personnel in their analysis of the funding and treatment measures required to deal with the cedar.

Mapping of the rangeland infestation problem in Barber County is now nearing completion (see KARS Newsletter, October 1975). KARS staff are presently preparing to accomplish a similar study of Pottawatomie County. Base line land cover data will be interpreted from 1950 ASCS photos of the county. High altitude color infrared aerial photos flown by NASA in November, 1973 will be used to obtain information on recent expansion of woody species into rangeland areas. Maps compiled from both dates will be registered to USGS 1:24,000 topographic maps. It is anticipated that preliminary data will be available by early July 1976.

(J. Merchant)

## RSEMS

RSEMS (Remote Sensing of the Electro Magnetic Spectrum), the quarterly Newsletter of the Remote Sensing Committee of the Association of American Geographers, is in its third year of publication. The most recent issue (January 1976, Vol. 3, No. 1) includes a directory of individuals, mostly from the field of geography, with an interest in remote sensing. In addition to general news items and announcements concerning the field, RSEMS carries short technical articles, reviews of new books and publications, and discussions of activities at remote sensing centers. The format is more akin to that of a small journal than a newsletter, the recent issues exceeding 60 pages. To help defray the increasing costs of printing and mailing, a \$3 per year charge is made to all subscribers. For further information contact the editor, Dr. Gary Higgs, Center for Applied Urban Research, College of Public and Community Services, The University of Nebraska, Box 688, Omaha, Nebraska 68101.

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## UPCOMING EVENTS

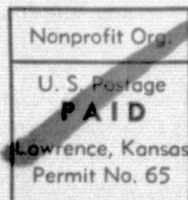
18-20 May, 1976 SHORT COURSE ON RADAR SYSTEMS FOR REMOTE SENSING, University of Kansas, Lawrence, Kansas. A course for managers, engineers and scientists concerned with design and application of radar systems. Imaging radar systems are the primary subject of the course, but relevant fundamentals of radar systems and the knowledge of radar backscatter phenomena will be summarized. Course instructors will be Dr. Richard K. Moore, Black and Veatch Professor of Electrical Engineering, University of Kansas; Dr. F. M. Dickey, optical processing specialist, The Boeing Company; Dr. M. W. Long, consultant; and Dr. F. T. Ulaby, Professor of Electrical Engineering, University of Kansas. Registration fee is \$300. For further information contact Francis Winterburg, K. U. Continuing Education Building, Lawrence, Kansas 66045.

20-22 July, 1976 AMERICAN SOCIETY OF CIVIL ENGINEERS SPECIALTY CONFERENCE: APPLICATIONS OF AEROSPACE TECHNOLOGY TO SOLAR ENERGY AND REMOTE SENSING, Colorado State University, Fort Collins, Colorado. In addition to papers, one-day short courses will be held on solar energy and remote sensing on 19 July. For further information contact: ASCE Specialty Conference, Engineering Research Center, Colorado State University, Fort Collins, Colorado 80523.

25-29 October 1976 THE SECOND ANNUAL WILLIAM T. PECCRA MEMORIAL SYMPOSIUM: MAPPING WITH REMOTE SENSING DATA, EROS Data Center, Sioux Falls, South Dakota. For further information contact: Dr. Robert B. McEwen, U.S. Geological Survey, National Center, #510, Reston, Virginia 22092

*The Kansas Applied Remote Sensing Newsletter is published in January, April, July and October by the University of Kansas Applied Remote Sensing (KARS) Program with facilities located in the Space Technology Center, Nichols Hall of the University of Kansas. The Newsletter is made possible through NASA Office of University Affairs Grant No. NGL 17-004-024. Contributions of research findings, announcements of meetings, publications, and information pertinent to remote sensing applications in Kansas or the Mid-West/Great Plains region are encouraged. Inquiries and contributions should be addressed to, Editor, KARS Newsletter. All correspondence related to specific projects should be addressed to the person indicated.*

The University of Kansas Center for Research, Inc.  
KARS Newsletter  
2291 Irving Hill Drive - Campus West  
Lawrence, Kansas 66045



PLEASE POST

## **APPENDIX II**

### **Supportive Letters**

STATE OF KANSAS

*Forestry, Fish and Game Commission*

NORTHEAST REGIONAL OFFICE  
215 SOUTH SETH CHILDS ROAD  
MANHATTAN, KANSAS 66502

June 6, 1975

Mr. D. G. Barr  
Satellite Application Program  
University of Kansas Space Technology Center  
Lawrence, KS 66044

RE: Douglas State Fishing Lake

Dear Dr. Barr:

This letter is a request for your assistance in obtaining aerial photographs of Douglas State Fishing Lake southeast of Lawrence.

We are planning a shoreline deepening project at the lake to reduce the extent of aquatic vegetation coverage. The aerial photographs would be used to determine the area and depth of coverage of aquatic vegetation.

These above parameters are needed to determine:

1. The extent of deepening needed.
2. The cost of the planned project.
3. The feasibility of the project.
4. A pre-project status.

Your assistance in this project would surely be appreciated. We will be looking forward to hearing from you.

Sincerely,

*Richard D. Wettersten*

Richard D. Wettersten, Director

RDW:DLD:lac

cc: Jim Merchant  
Roy Schoonover  
Leo Dowlin

**OFFICERS**

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Commissioner  
Johnson County, Ks

**Vice Chairman**  
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Jackson County, Mo

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Overland Park, Ks

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Councilman  
Kansas City, Mo

**Secretary**  
ALAN PETERSON  
Mayor  
Fairway, Ks.

**Executive Director**  
ROBERT F. DAVIS

# MID-AMERICA REGIONAL COUNCIL

20 West 9th St., Third Floor, Kansas City, Mo. 64105, Phone 816-474-4240

# MARC

April 22, 1975

Mr. Jerry Coiner  
Senior Research Scientist  
Space Technology Center  
University of Kansas  
2991 Irving Drive  
Lawrence, Kansas 66045

Dear Jerry:

Just a short note to thank you for your efforts in helping us to determine a better way to split Census tracts by using the Space Center N.A.S.A. Application Program.

The balance of housing, population and other homogeneous factors within the areas suggested by your analysis of the U-2 photography has checked out beautifully with supporting Census and local data.

This material is to be presented to the local regional "Census Tract Committee" later this month. You will be sent an announcement of the meeting should you wish to attend.

We hope to use new techniques of remote sensing, U-2 and other imagery in as many instances as possible to further our efforts in providing a statistical base for study of urban problems.

We hope you will be able to continue this aid as needed.

Sincerely,



Truman Cleveland  
Supervisor Data Services

TC:gjb  
cc: Dick Cavender

STATE OF KANSAS

*Forestry, Fish and Game Commission*

SOUTHWEST REGIONAL OFFICE  
808 HIGHWAY 56  
DODGE CITY, KANSAS 67801

Build a Pond  
Plant a Bush  
Grow a Tree

March 2, 1976

Mr. Ted L. Talmon  
Research Scientist  
Space Technology Center  
Raymond Nichols Hall  
2291 Irving Hill Drive - Campus West  
Lawrence, KS 66045

Dear Ted:

Enclosed is the job description material for the proposed lesser prairie chicken study. At the back of this description are various estimated costs and man day figures. As you will note, beginning date was two weeks ago and completion date is June, 1977. Without extensive use of aerial imagery, I do not believe the project will be completed on time. I can envision much more use of aerial imagery than is shown here in the job description. Our present budget problems are holding up this project temporarily, but I would look for this study to be initiated very shortly.

I am going to ponder the Barber County data a bit further regarding its use in antelope and wild turkey utilization. Hopefully I will be in the Norton area this week and will discuss this remote censusing operation with our two people, so that they can be of more assistance to your man when he comes around up there.

The discussions yesterday were most interesting, but it did make for a long day. Keep in touch!

Sincerely,

*Bill Hanzlick*  
Bill Hanzlick  
Regional Management Supervisor

BH:ck

Enc.



UNITED STATES DEPARTMENT OF AGRICULTURE

SOIL CONSERVATION SERVICE

See-Kan RC&D Project Office, Box 502, Chanute, Kansas 66720

January 22, 1976

Dr. Bill Barr, Director  
Space Technology Center  
2291 Irvin Hill Road  
Lawrence, Kansas

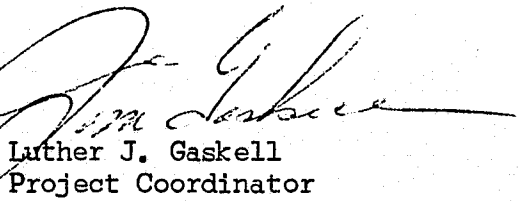
Dear Bill:

I want to express my appreciation to you for your presentation Monday night to the See-Kan RC&D Board. I have heard numerous favorable comments concerning the information presented. Please extend my thanks to Ed and Ted also for their part.

I am enclosing copies of two clippings from the Chanute Tribune regarding your presentation. The See-Kan RC&D Board appreciates this type of news coverage.

Again, my thanks to you. I will be looking forward to working with you later on some specific projects for our area.

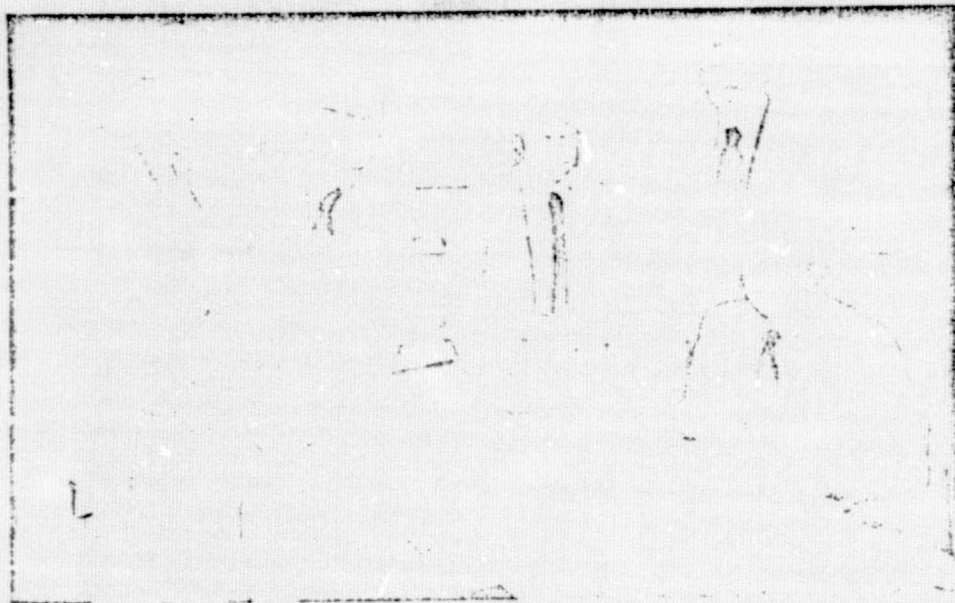
Sincerely,



Luther J. Gaskell  
Project Coordinator

2 Enclosures

cc:  
Kenneth Harts, Pres., See-Kan RC&D, Walnut



## Aerial research

The See-Kan Resource Conservation and Development Project, Inc., board receives information about the Center for Research, Inc., at the University of Kansas, Lawrence, about aerial photography to help in land and water research. From left are Kenneth Harts, Walnut, president of the See-Kan board; Jim Gaskell, project coordinator for the Soil Conservation Service; and from the center, Ted L. Talmon, research scientist, Dr. Edward A. Martinko, project coordinator, and seated, Dr. Bill Barr, executive director.

## Research and aerial photography spotlight See-Kan RC&D meeting

By JANE BLADES

RIIE - Illustrations of the way research and aerial photography can assist the Soil Conservation Service in improvement projects and solving problems were part of the monthly meeting Monday of the See-Kan Resource Conservation and Development Project, Inc., board.

Topographical aerial photos were shown by Dr. Bill Barr, director of the space technology center at the University of Kansas, Lawrence, Dr. Edward A. Martinko, project coordinator, and Ted L. Talmon, research scientist. Barr explained the photographs were taken from "low flying aircraft, high flying aircraft and in cooperation with NASA aircraft and satellite."

Barr said from the satellite, which travels 560 miles overhead, reproductions are mainly patterns and the research center is learning to use the data accumulated. Data has been developed about wheat crops, moisture and weather conditions, he said. He cited a project involving eight counties in Kansas and Missouri showing implications to the states and nation in efforts to change prime farm land to urban uses.

Martinko, who recently joined the center from Colorado Springs, Colo., discussed projects served by research

from the center, including Kansas City, Kan., where a new trash collections contract seemed excessive, the Cheyenne Bottoms Waterfowl Management Area where vegetation was increased to the extent that water was decreasing, the Republican River where a canoe trail was developed to revitalize facilities.

Talmon explained how photographic overlays provided a complete picture of Cherokee County in urban and built-up land, larger farms, crop lands, conservation areas, pastures, reclaimed lands, feeding operations, forest, water, wetlands, sewage treatment and ponds.

"We don't want to fingerprint anymore," Barr laughed as he said the center has developed techniques for using the equipment available. He urged that requests be made to the president of the board for help in any project and that the center be contacted to help with research and suggestions for solving problems.

Jim Gaskell, project coordinator for the Soil Conservation Service, in reporting the meeting of the Water Resources Board, said water is available for purchase from storage purchased by the state to supplement state water supplies.

He said the quality of water improves as reservoirs help make water clean and cities improve sewage treatment plants

to prevent silt accumulating in water bodies.

The board agreed to support the Shoal Creek Reservoir proposal benefiting Girard city and two rural water districts in a multi-purpose project for water supply, flood control and recreation facilities. The area includes 440 acres, the northeast part of Crawford County. The project was substituted for a single purpose flood control project, Tom derbold Dam, in the south part of Crawford County.

It was announced that the Shoal Creek Recreational Area project supporters will ask for a feasibility study, who mayors of Baxter Springs, Columbus at Galena meet with Cherokee County commissioners in Columbus Jan. 20.

Gaskell discussed a bill for scenic and recreational rivers act to protect "scenic areas being eroded and ruined by man." The legislation would suggest areas designated as scenic be maintained by the state. "When pollution destroys them, the scenic areas would involve contracts between the Kansas Parks and Resources Authority and land owners to preserve natural beauty. Water use easements for adjacent lands would be included, Gaskell said.

The nominating committee developed slate of officers to be elected at a February annual See-Kan RC&D meeting.

FORECAST:  
Thawing

# The Chanute Tribune

PRICE 15c

CHANUTE, KANSAS, 66710, TUESDAY, JANUARY 20, 1976

12 PAGES

## President's state of union address includes election platform

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**LAND USE PATTERNS** — This map of Kansas showing land use patterns, is the produce of the Space Technology Laboratories at the University of Kansas, Lawrence. Much of the light gray area is unirrigated cropland; the darker gray areas locate areas with some

irrigation; the light areas depict rangelands. The dark areas marked 1 are forest areas and the dark areas marked 2 are urban and builtup land areas.

## Aerial research helps land use

A SHORT COURSE in remote sensing aerial photographic interpretation and terrain analysis is scheduled March 15-19 at the University of Kansas, Lawrence.

The course, given in cooperation with the KU satellite applications laboratory at the Space Technology Center, explores data-producing capabilities of aerial photography to illustrate how geologic, soil, vegetation and land use information can be interpreted and applied to issues of site development.

Since April, 1972 the applications laboratory has conducted a program designed to assist decision makers in local, state, regional and federal agencies in the application of remote sensing techniques to their activities. Remote sensing can be defined as the acquisition and interpretation of data collected by non-contact methods using aircraft and satellites.

These methods usually involve the presentation of data in a photo-like format. The purpose of the technology is to acquire data about man's activities on the earth's surface and the environment in which these activities take place.

Aerial photography was used to develop the map shown above of remote sensing applications projects in Kansas. Satellite images may be taken every 18 days as the NASA satellite makes its trek in the sky.

The See-Kan Resource and Conservation Development Project, Inc., board board representatives of the Lawrence center illustrate and explain projects the center has participated in

with Kansas groups. Dr. Bill Barr is center director.

One project, for instance, in Kansas City, Kan., concerned renewal of the refuse hauling contract. The cost of the new contract for the service seemed excessive to the city council and the research center was asked to study the problem.

The center, after research, suggested dividing the community into seven areas for trash pickup and offering separate territories for bids. The original collector decided the divisions and suggested schedule of collections during the month would be feasible at a cost less than his original bid and the problem was solved.

In the Cheyenne Bottoms Waterfowl Management Area in Barton County, vegetation was increasing to the extent that space for water was decreasing. Photographs of the area, taken by the center, revealed an earlier game manager had blasted holes in the terrain to disperse vegetation. Controlled blasting was arranged and the present vegetation dispersed to permit a greater flow of water in the area.

A canoe trail and recreation possibilities were developed with the help of the center on the Republican River in north-central Kansas. After flood waters made an original study obsolete, the Lawrence Center helped the area redefine areas and suggest desirable campsites.

The project was the result of a study to help revitalize facilities in the area by the Four Rivers RC&D and the Concordia

Chamber of Commerce. A map was provided to show potential campsites along a stretch of the river from Concordia to Clyde.

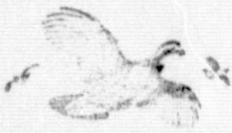
In March, 15 projects in Kansas involved the Lawrence center in some form of research. The applications program will locate, acquire and interpret photographs or images from aircraft or space craft and supply the interpretation products to the decision makers for the

projects; provide training to agency personnel; provide consultation on the use of remote sensing information derived from a study.

The laboratory is staffed by several graduate students working in the fields of geography, cartography, environmental health sciences and biology. Photographic, drafting and compute services are available at the Space Technology Center.

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STATE OF KANSAS

*Forestry, Fish and Game Commission*



SOUTHEAST REGIONAL OFFICE  
222 WEST MAIN  
SUITE C AND D  
CHANUTE, KANSAS 66720

February 20, 1976

Mr. Ted Talmon  
Research Scientist  
University of Kansas Center for Research, Inc.  
2291 Irving Hall Drive- Campus West  
Lawrence, KS 66045

Dear Ted:

The maps you provided did help in the selection of sampling stations. The sampling stations were marked on old maps merely because we did not want to mark up your maps at this time. Our stations are also tentative and approximate, based upon access, character of flow, etc. known at this time. It is also possible we will modify our degree of sampling dependent upon investigations by other Agencies such as the State Board of Health.

Enclosed is a map which indicates all the strip mined areas owned or managed by the Kansas Forestry, Fish and Game Commission at this time. Hope this is adequate and if not, please contact me.

Very truly yours,

Johnny Ray  
Regional Game Supervisor  
Southeast Region

JR/kg

Enclosure



# KANSAS DEPARTMENT OF AGRICULTURE

STATE OFFICE BUILDING  
TOPEKA, KANSAS 66612

ROY FREELAND  
SECRETARY

Weed and Pesticide Division  
FREEMAN E. BIERY, Director  
1720 SOUTH TOPEKA AVENUE  
TOPEKA, KANSAS 66612  
Phone (913) 296-2263

November 24, 1975

Professor B. G. Barr  
Executive Director  
Space Technology Center  
West Campus  
University of Kansas  
Lawrence, Kansas 66045

Dear Professor Barr:

I have learned of a research project of the space technology program concerning the infestation of pasture land with red cedar. It is my understanding that the investigative work is being done in Barber County, Kansas.

We have another area of Kansas which appears to have a growing problem with red cedars infesting the pastures. This area is Riley and Pottawatomie counties.

We need to know more about the extent of infestation. Also, we need to determine the extent of spread of the problem by looking back or looking ahead via aerial photography.

Senator Dole's office has become interested in the problem and we are in need of supplying information for him and other persons concerned with the apparent problem.

Would it be possible for the space program to extend its work to give us needed information on the situation in Riley and Pottawatomie counties.

We look forward to hearing from you.

Sincerely yours,

Freeman E. Biery, Director  
Weed & Pesticide Division

FEB:mls



STATE OF KANSAS

Forestry, Fish and Game Commission

SOUTHWEST REGIONAL OFFICE

808 HIGHWAY 56

DODGE CITY, KANSAS 67801

March 31, 1976

Build a Pond  
Plant a Bush  
Grow a Tree

Mr. Ted L. Talmon  
Research Scientist  
Raymond Nichols Hall  
2291 Irving Hill Drive - Campus West  
Lawrence, KS 66045

Dear Ted:

This is in regard to your request for additional information on acreages and landowners in the WHIP program relative to the sandyland areas around Garden City.

The district biologist at Garden City has worked out various habitat plans for landowners in that area. One landowner in particular has a large number of circle units south of Garden City. This is one of the Gigot brothers, who together probably have 300 circle units in that area. The wildlife plan that was developed for Terry Gigot included a few corners in his circle system, and Mr. Gigot provided some money for habitat planning to improve corner vegetation with both tree plantings and native grass seeding. We have no accurate information regarding the number of acres each WHIP cooperator develops for wildlife. A plan is drawn up for either their entire acreage, and in this case, Gigots acreage exceeds 2,000, or in some cases, only specific areas of a farm are considered for wildlife. Further, what the landowner accomplishes in the way of habitat development is his decision.

We have drawn up plans for approximately 50 landowners in the western area. These plans range from acreages of 2 to 2,000. In most cases, the landowner has done nothing with our plan. In a few instances, the landowners are incorporating their entire farm into some type of wildlife program. Until we check back with each WHIP cooperator, we do not know how far he has progressed, or if he has done anything. In our country, throughout the western region, we are finding that the city landowner is more interested in habitat improvement than the true farmer. The latter group is too busy or too concerned with crop production or growing red meat. Wildlife conservation is not in his plans at present.

I am aware of what you need in the way of crops and acreages, wildlife plans, etc., but any cooperator-acreage figures that I might send you would probably not even be nearly close to accurate. For instance, the 2,000+ Gigot acres probably will have no more than 100 actual acres developed for wildlife.

The WHIP program is having very little affect upon the destruction of sand-sage prairie around Garden City. Once the center pivot systems move in and the prairie is destroyed (the WHIP program has no affect upon this), we are then forced to work with landowners on the remaining undisturbed acreage in the corners of these circle systems. At this point, the lesser prairie chicken has moved out of the area, and our only hope is to provide habitat for whatever wildlife species that are able to survive in this type of cropping system.

Mr. Ted L. Talmon  
Page 2  
March 31, 1976

The center pivot map that you provided is presently providing us with locations of undisturbed sandsage prairie. Destruction of the sandsage prairie has progressed to the point where we are trying to locate remaining booming ground areas for prairie chicken mating activities, and also we are seeking to find ways of preserving any large block of this remaining sandsage prairie.

As you will recall, I had mentioned that we are working with one landowner to set aside a 10,000 acre ranch south of Holcomb to preserve the remaining lesser prairie chicken habitat. Upon receipt of the updated information relative to center pivot systems in that area, we will be able to use this information in our discussion, with this landowner as well as any others, on the complete destruction of the sandsage prairie.

I plan to make a pitch to our Kansas-Oklahoma Chapter of the Range Society in regards to the preservation of this sandsage prairie. I feel that these people should become more concerned about it, and I also plan to present a paper to the National Range Society Meeting in Portland next year regarding this subject. With the permission of your outfit, I hope to use the various maps and data you have provided to persuade this group to become involved in the preservation of this unique plant community. Various interests get concerned about the whooping crane, the black-footed ferret, some little known species of minnows, and other wildlife, but they let entire plant communities be destroyed and never say a word. Of course, the accompanying wildlife communities are also destroyed, and we lament that fact long after it is too late to do anything. Maybe we have done that already with the area around Garden City.

I am sure I did not provide you with the precise information you desire. You are, of course, still seeking definitive decision making that occurred from your circle irrigation imagery and data. If this preservation of the sandyland prairie occurs, even to the point of setting aside this 10,000 acre ranch, your imagery and data will have been the prime factor in this. I know for certain that this land is worth \$5,000,000, and I don't see the possibility of putting a price on the wildlife communities that are also preserved. Nevertheless, there is a great deal riding on this operation at present.

I have rambled long enough and will quit, but would appreciate your updated information and imagery on this when it becomes available.

Sincerely,

  
Bill Hanzlick  
Regional Management Supervisor

RU:ah





STATE OF KANSAS

*Forestry, Fish and Game Commission*



SOUTHEAST REGIONAL OFFICE

222 WEST MAIN

SUITE C AND D

CHANUTE, KANSAS 66720

September 12, 1975

Mr. Ted L. Talman  
Research Scientist  
University of Kansas Center for Research, Inc.  
2385 Irving Road - Campus West  
Lawrence, KS 66044

Dear Ted:

Sorry this letter is so belated as field work has kept me very busy. Thank you for the drainage maps of the (Lightning Creek-Mined Land Maps) of Cherokee County. The procurement of these maps will assist our fisheries section in the following manner:

1. Delineate both old and current drainages from which we can plot any drainage changes due to past strip mining activity.
2. Provide a base map on which we plot existing paths of strip mine acid pollution to the Neosho River system.
3. Abet our efforts to adequately program aquatic biota sampling stations under our current Phase II Stream Survey.
4. Establish an easily reproduced map on which we can designate needed pollution control measures to higher authority, both aquatic and terrestrial.

The overlay map and quad sheets have already been used while directing Assistant Kansas Attorney Generals in a tour of existing Southeast Kansas Mined Land Pollution and explaining the need for pollution abatement. They are currently being used for sampling station selection and definition of where the most heavily mined land pollution exists within the Lightning, Cherry and Deer Creek drainages.

Hopefully once my heavy field work load is accomplished and at your convenience, I can visit your office and discuss with you the potential for acquiring further information.

Thanks again.

Very truly yours,

*Johnny Ray*

Johnny Ray  
Regional Fisheries Supervisor  
Southeast Region



APPENDIX III

Republican River Canoe Trail Brochure

# REPUBLICAN RIVER CANOE TRAIL

The Republican River Canoe Trail was developed to provide enjoyable recreation for canoeists, nature lovers, youth groups, and other outdoor enthusiasts. The natural setting of the shallow, lazy flow of the Republican River offers peace and quiet among the river fauna.

## Course Description

The trail begins at the US-81 highway bridge about one mile north of the city of Concordia and wanders eastward approximately seven miles to the old Burlington bridge. The course is considered EASY as generally described by canoe difficulty ratings. The riverbed is sand, bending without difficulty with occasional small rapids and pools. The correct course is easy to find; but care is needed with minor obstacles such as shallow flows, fallen trees, etc. The river speed is less than hard back paddling speed.

The campsites are sand islands with varying degrees of cover. The sites are primitive with no facilities.

## River Flow Data

The National Weather Service, Concordia, Kansas (phone 913-243-3141), maintains a constant vigil on the depth of flow for the Republican River. The following table shows the average flow depth each month from 1970 to 1975.

Apr. 2.00 ft.	Aug. 1.55 ft.
May 2.03 ft.	Sept. 1.56 ft.
June 2.05 ft.	Oct. 1.60 ft.
July 1.81 ft.	

Flood Stage = 10.0 ft. flow depth

## AND THE CLOUD COUNTY COMMISSION

## Floater and the Landowner

Floating is relatively new to Kansas streams. Through cooperative agreements with landowners, access to this trail has been achieved. To fulfill the floater's use of the established trail, care should be exercised to limit access within the confines of the river stream bed and the adjacent identified areas on the map. The map contains all access areas, including entry and exit, campsites, and nature areas.

In addition the Outdoor Code of Conduct is to be exercised during trail use.

- I will at all times display respect for the land and water, treating the same as a valuable and finite natural resource.
- I will secure or seek permission before entering private land with wheeled vehicles.
- I will not chase or harass livestock, leave gates open, cut fences, or in any way vandalize private property.
- I will gain access to streams and rivers at public road bridges or will use private access with permission only.
- I will carry out and/or properly dispose of all my litter including litter left behind by others when possible.
- I will respect all fishing and hunting laws and will not discharge firearms except where permitted by law and then only in a safe manner.
- All campfires will be properly attended.

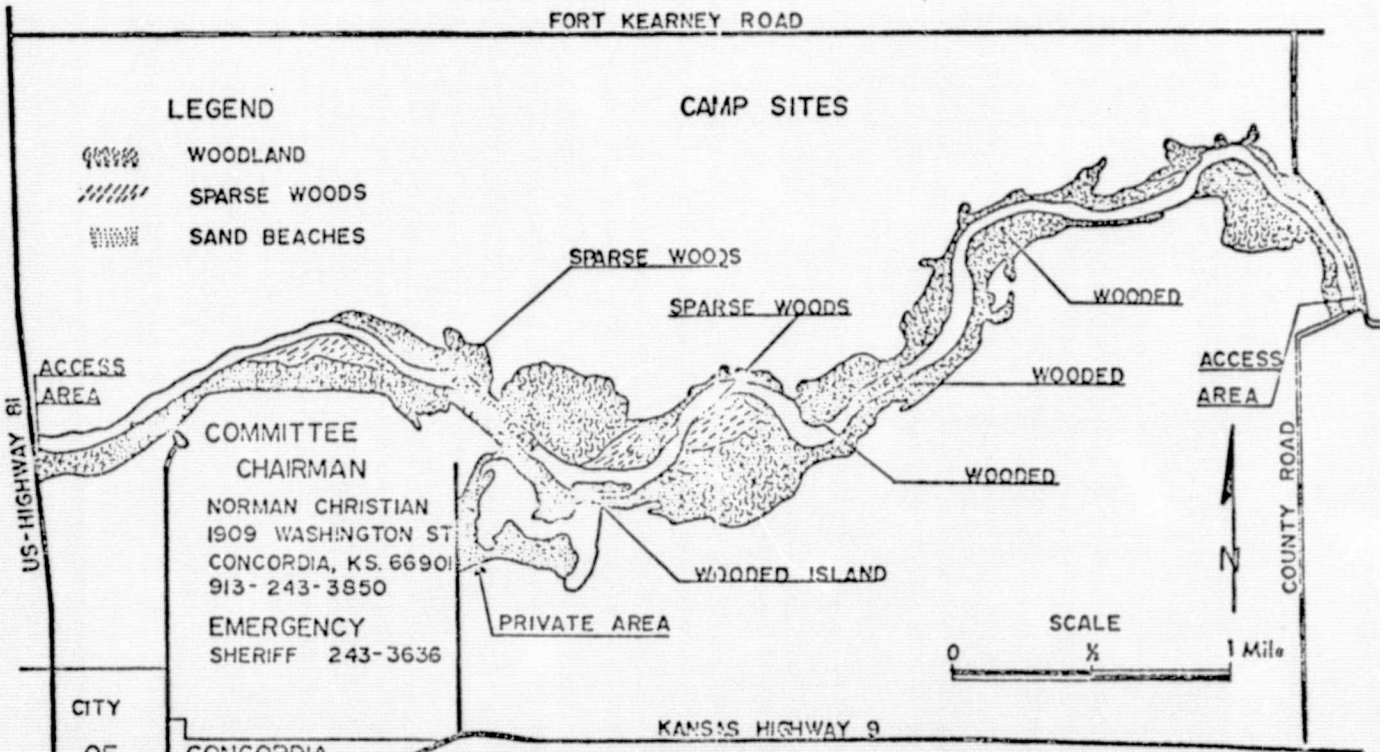
## Safety Rules for Canoeing

Canoeing is a safe mode of transportation providing one uses the common sense safety precautions. Canoes are ideal for fishing, camping, and other recreational purposes, providing fun and the opportunity to develop a skill. Canoes also provide exercise, silent invasion of nature, fauna, and recreational enjoyment at a reasonable cost.

The proper use of a canoe is basic to a safe and sane journey.

- Don't ever stand up in or overload a canoe.
- Know the flotation capacity of your canoe.
- Beginners should kneel in a canoe leaning against the canoe seat.
- In rough water, keep low in canoe and head into the waves.
- Keep watch for obstructions.
- Wear a Coast Guard approved life jacket.
- Never run a canoe onto shore or run the bow too far ashore.
- Always keep your weight and cargo as low as possible in the canoe.
- When accidentally swamped, stick with your canoe. It can be your best life preserver.

For additional safe canoe operations, refer to Canoeing, Merit Badge pamphlet, BNA, and Basic Canoeing, American Red Cross.



OFFICIAL FLOATING SEASON APRIL 15 TO OCTOBER 15  
WRITTEN PERMISSION REQUIRED BEYOND THESE DATES.

ORIGINAL PAGE IS  
OF POOR QUALITY

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